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SCIENTIFIC AMERICAN

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THE TREATY CRUISER

By Hector C. Bywater

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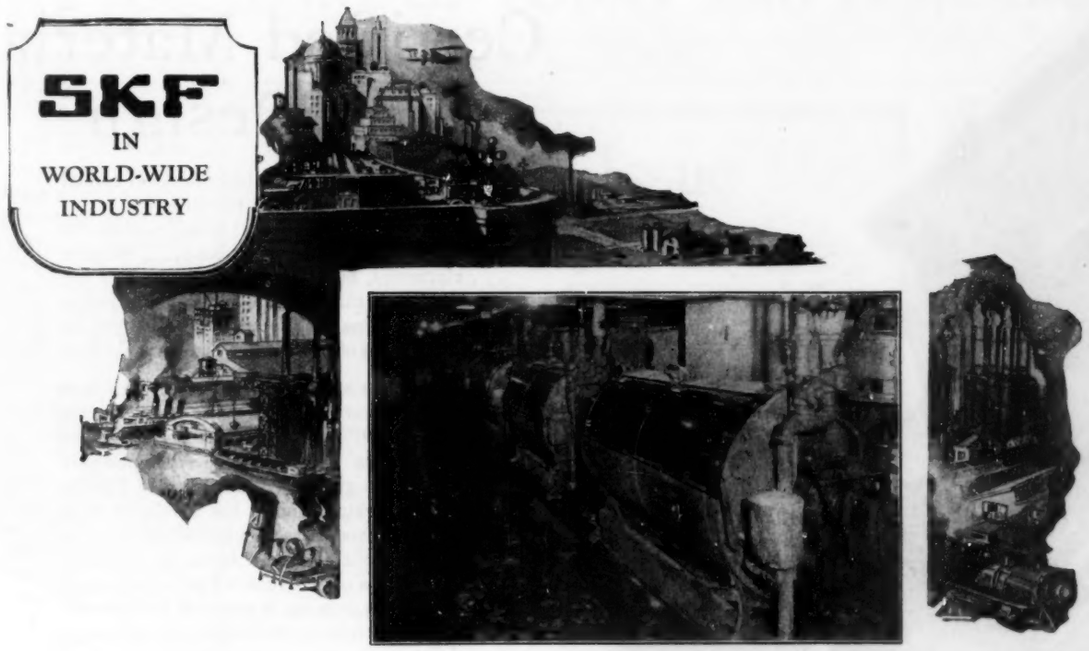

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, NOVEMBER, 1926 | *Edited by* ORSON D. MUNN | EIGHTY-SECOND YEAR

ANNOUNCEMENT

BEGINNING with next month's issue, the Scientific American will include a department devoted to medicine. It will be a regular monthly page like those we have published on astronomy during the last 26 years. It will be prepared by Dr. Morris Fishbein, Editor of the famed *Journal of the American Medical Association* and of the popular journal *Hygeia*. For a long time we have wanted something of this sort—straightforward, non-technical, *authentic*. To get it was another question.

More and more the magazines—and even the newspapers—are full of much-heralded medical discoveries—cures for cancer, tuberculosis, what-not. One and all, we have long refused absolutely to publish these, for too often they give false hope to real sufferers and thus cause added anguish.

Dr. Fishbein, it is hoped, will not only write about medicine and surgery, but he may attempt to assess the significance of some of the current cures, thus providing the hopeful patient with that which the usual announcement seldom provides him—a really conservative basis on which to judge them.

Our readers are honored by Dr. Fishbein's consent thus to serve them.

"AIRGRICULTURE"

ARMY Air Headquarters in Hawaii report cooperation with the Hawaiian Board of Agriculture and Forestry in sowing tree seeds by airplane on forest reserve lands which had been devastated by fire. Two amphibian planes, working in an area of four square miles, distributed a total of 24 bags of seeds. It is estimated that in an hour and a half flying time two men accomplished as much as two men working on the ground could have done in ten years.

COSTLY

THE Scientific American moved out of the highest building in the world—the 57-story Woolworth Building—just in time, for Detroit is planning a higher one—the Book Building. It is to be eighty stories high! Thus, New York loses the lead in skyscrapers. Well, what of it! For a period of years, skyscrapers were a great advertisement. Then they became too commonplace to thrill a blasé world. Moreover, 900-foot buildings are not the most profitable, any more than 900-foot steamers are. In both cases, it is the largest that attracts the most notice but the medium sized that attracts the most money. Let Detroit have her fun and her thrill. Sour grapes? Perhaps a trifle, but ours are crocodile tears. New York is planning a building still higher!

In This Issue

The Navy's New Cruiser
When the world's diplomats convened at Washington two years ago they laid down conditions which virtually forced the great powers into building a standardized cruiser. A well known naval expert now says that these cruisers are the "unwanted offspring of a diplomatic compromise." On page 327 the same expert says other things too, equally poignant.

Making Atoms Confess
When a lawyer wants to reveal the inmost thoughts of the witness he endeavors to get him excited. So with the physicist: when he gets an atom "excited," it tells all sorts of things on itself. This month, commencing on page 330, Prof. K. T. Compton, noted physicist, explains some of the atom's inner workings under excitation.

Which One Is Right?
In the July issue a noted anthropologist, Dr. Ales Hrdlicka, virtually denied that man had been long in America. This month another scientist, Harold J. Cook, takes strong issue with him, claiming that there is evidence that man has been in America for hundreds of thousands of years. Read pages 334 to 336.

How Much Dust In the Air?
Now that man has learned to fly he finds a need to know just how many dust particles a given volume of air contains. Some remarkably interesting work has been and is being done along this line. See page 346.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 400.

For Next Month

The Smallest Lamp In the World
Not the tiniest electric bulb, but the luminous bacteria which appear on fish or meat and in other unusual places—these are much the smallest lamps in the world. They are intensely interesting. For one thing their overall efficiency is about 100 percent, while that of an electric lamp, only 3 percent! In the December issue Prof. E. Newton Harvey will tell of them.

The Remarkable New Cathode-Ray Tube
Dr. William D. Coolidge, noted Assistant Director of the research laboratories of the General Electric Company, recently announced a cathode-ray tube far more powerful than any previously known. Its significance is likely to prove immense. Next month, some of its striking effects will be described.

Physics of the Golf Ball
In the August issue Dr. Sheldon explained some of the shortcomings of the golf ball. We knew when this article was published that it would arouse controversy among golf enthusiasts. It has! In the next issue a golf expert will answer some of the questions which the previous author raised.

Other articles on The American Toy Industry; The Chimes of Catalina Island; The Scientific Reduction of Garbage; A Herd of Unique Hybrids; Snow Crystal Marvels; Rabbit Skins in the Manufacture of Furs; Out of the Inkwell; Manners and Customs of Ancient Egyptians; Astronomy; Radio.

MORE THAN 200 PICTURES

¶ **There is one best way to keep in touch with the leaders in the world's progress—by consistently reading the Scientific American.**

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TRANSMUTATION

WHEN the German, Dr. Miethe, announced that he had successfully transmuted mercury into gold he may be said to have "started something." For, ever since, numerous scientists have duplicated or paralleled his attempts with varying degrees of success or failure. Every time a scientist has announced that transmutation in his own hands has proved a success, another scientist has announced just as vigorously that in *his* hands it was a failure.

The Scientific American tests, conducted by our Corresponding Editor, Prof. H. H. Sheldon resulted in a demonstration that transmutation could not be effected by the methods employed. Now comes a British scientist, Dr. Milan W. Garrett of Oxford University, and tries the same experiment, duplicating the methods of Miethe. Result: failure—no transmutation.

Every time an announcement of this sort is made we feel a little more certain that Professor Sheldon was right.

HISTORY

ORGANIZATION of history as a science on a world-wide scale has begun with the announcement of the American Historical Association that a permanent international committee has been formed. A congress of scholars specializing in the historical sciences will meet in Oslo in 1928.

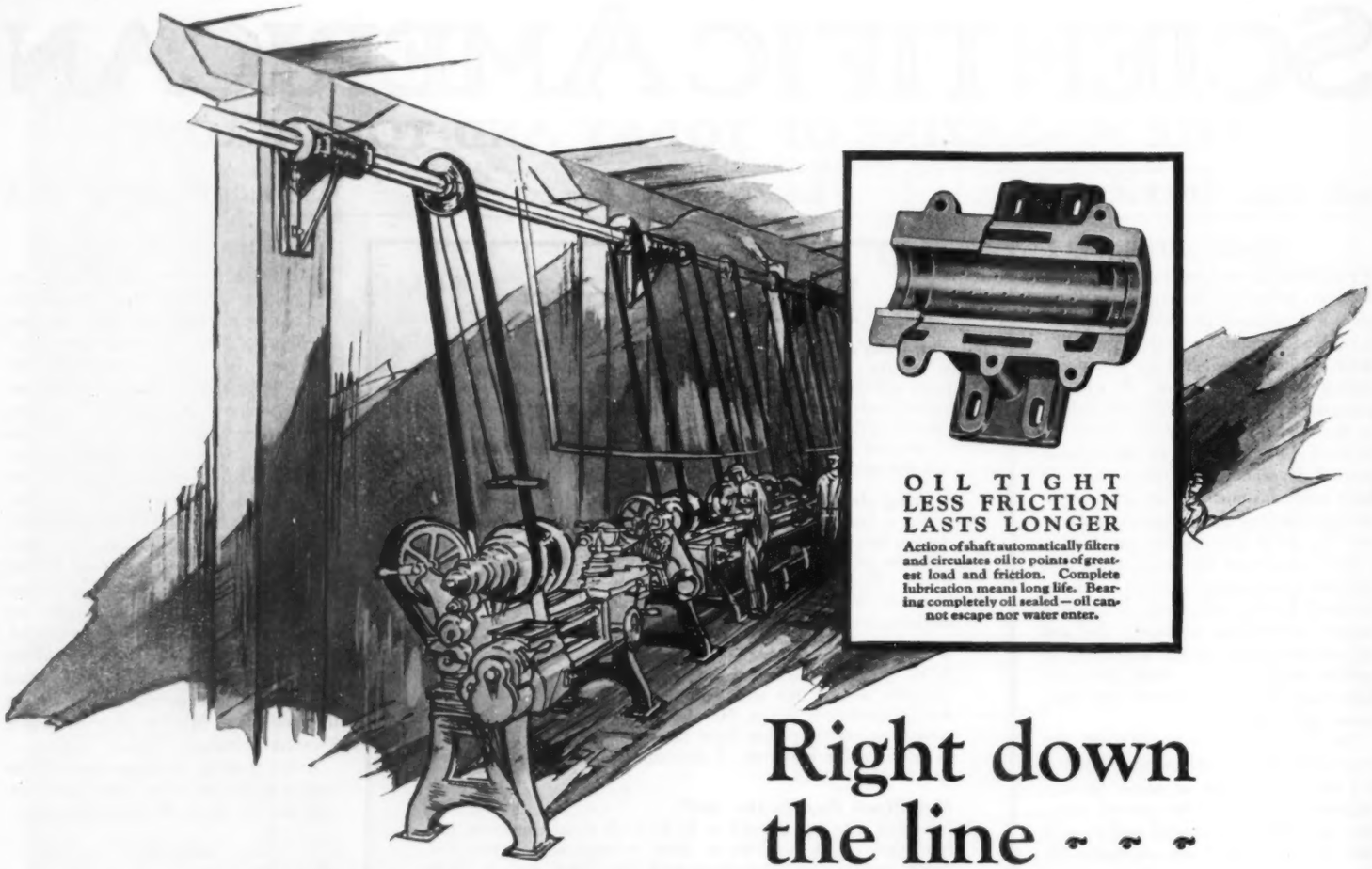
The organizers of the movement believe the new movement will free historical scholarship from the national prejudices and inhibitions of boundary lines, and that the friendly cooperation of scholars from all countries will react favorably on all intellectuals in all countries and through them on politicians and the people.

If we accept the simple definition, "science is classified knowledge," why should not history be an exact science? Too long has history been a matter of literature—and imaginative literature, at that. If only the nations can agree on the facts we will have gone a long way to making war unlikely.

SORRY

FEW indeed of us enjoy having our name misquoted. If our name is John Brown and someone addresses us as "James Browne" we feel irritated. If the newspaper spells our name wrong we feel we have legitimate grounds to commit murder.

We have just discovered that we misquoted the name of Roy Waldo Miner, author of "A Trip to the Bottom of the Sea," published in our August issue. His name is not "Ralph" Waldo Miner as we printed it. We hasten to make amends. We are sorry.



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VACUUM CIRCULATION
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THE sponsors of Navy Day have sought to establish at least one day in each year when the people of the country will turn their thoughts in a special way to the mission, needs and activities of our first line of defense.

The United States Navy of 1926 is not externally the infant Navy which challenged and successfully defeated the Barbary corsairs nearly a century and a half ago. Yet the same courage, fortitude and indomitable will so characteristic of our earliest sea commanders has wrought a wonderful transformation in the last one hundred and fifty years. Proceeding slowly for a time our small fleet of sailing vessels, manned by daring pioneers with improvised armament, has evolved into the majestic fleet of today. In 1775 Jeremiah O'Brien and his followers fought one of our first sea battles with a main armament consisting of pitchforks and farming implements. It is a far cry from the crude method of warfare to the great aircraft carriers and battleships that today constitute the backbone of our Navy.

© Harris & Ewing

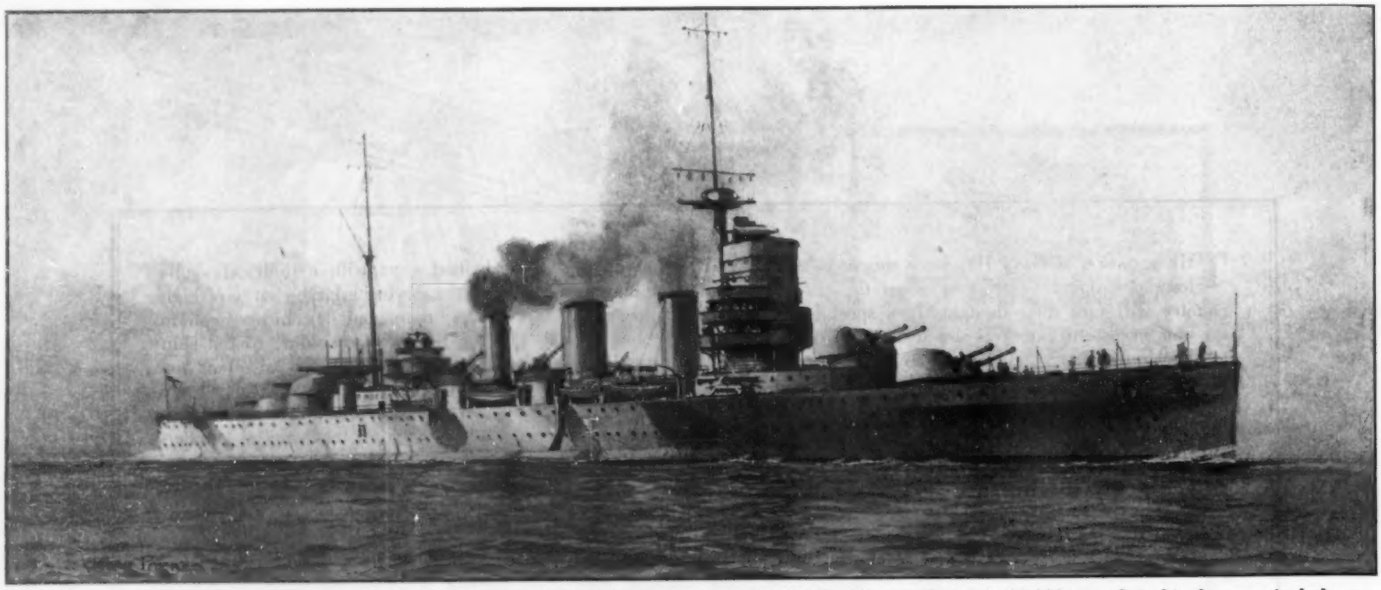
Slowly, painfully for a time, our Navy worked out its destiny. There were no hasty and irretrievable steps. The Navy's leaders have ever been men with broad vision keeping abreast of changing conditions, following the signs of the times, forecasting the future; their judgment tempered by the lessons of the past. There have been no cataclysmic changes in the country's seapower. Our Navy after years of experimentation grew out of sail into steam; from the vulnerable side wheeler it proceeded to the protected screw propeller; wooden ships became ironclads until exhaustive tests conclusively demonstrated the all-steel vessels of today. In the electrical era through which we are now passing our Navy has been the pioneer in the electric drive; the cast-iron guns firing round shot a few hundred yards have surrendered to the steel-rifled guns with cylindrical shells weighing nearly a ton and carrying a large charge of high explosive for many miles; the signal flag and semaphore are now assisted by the far-reaching radio; to the ship of the sea have been added its allies, the vessel of the air and the hidden craft of the deep. In 1776 our Navy proceeded on the surface at eleven knots. Today it almost equals that speed underneath the waters, triples it on the surface and multiplies it many times in the sky above.

In its progress the Navy personnel has played an important role. And the country at large has benefited by the pioneering spirit of the Navy man—scientifically, industrially and commercially. By fostering, encouraging, and assisting manufacturers our Navy's experimental work in radio alone has contributed greatly to the welfare of the American people. The educational advantages of this development can hardly be overestimated.

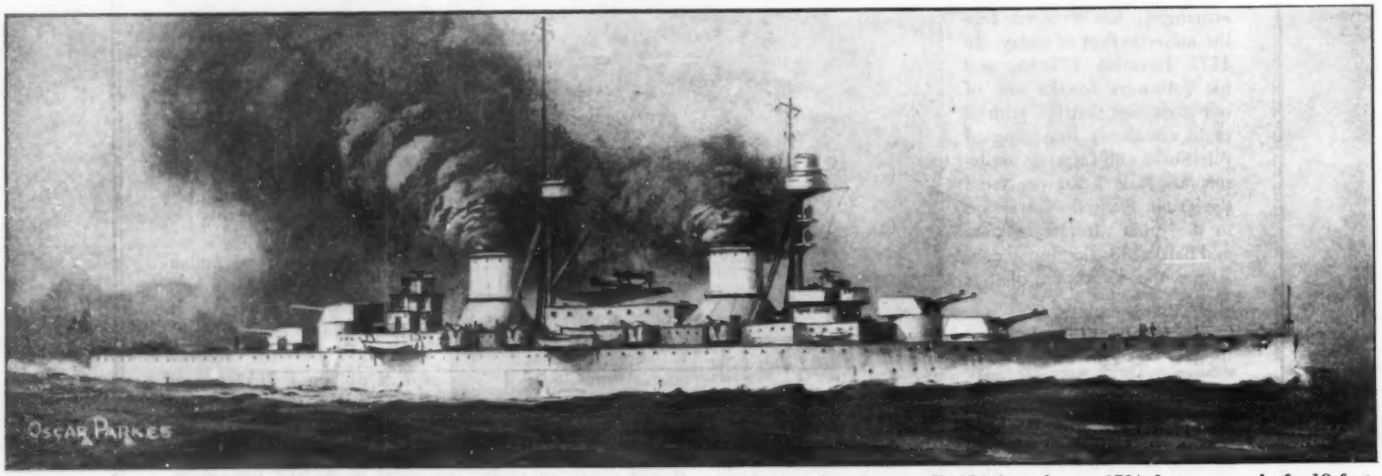
Ceaseless progress, unflagging determination have been the keynote of the Navy's attitude. Ships changed with the years but the resolute spirits of Jones, Decatur and Bainbridge have been perpetuated in their followers. The nation will be glad to know that the progressive spirit is still dominant in the personnel of its first line of defense and will agree with President Coolidge when he said:

"Our American Navy has always been much more than an arm of wartime defense. All the money that has ever been spent on the Navy has been returned to the community several times over in direct stimulus to industrial development. We may be very sure that in the future as in the past, the Navy's services to industry and the arts of peace and science will continue completely to justify its maintenance in the highest efficiency."

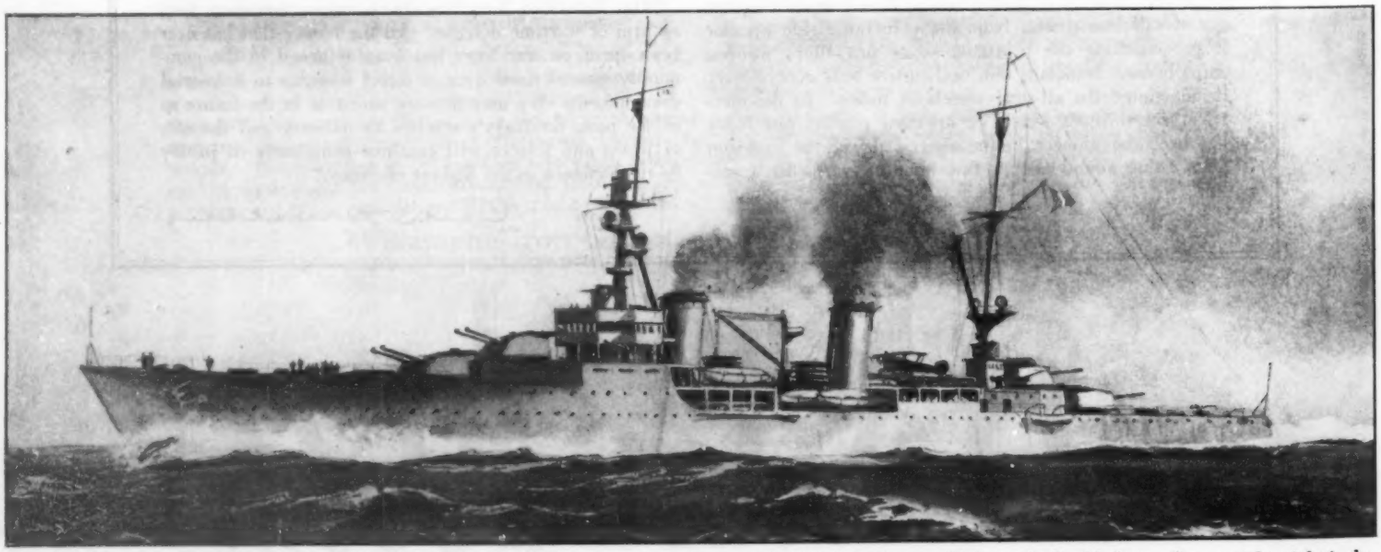
Calvin Coolidge



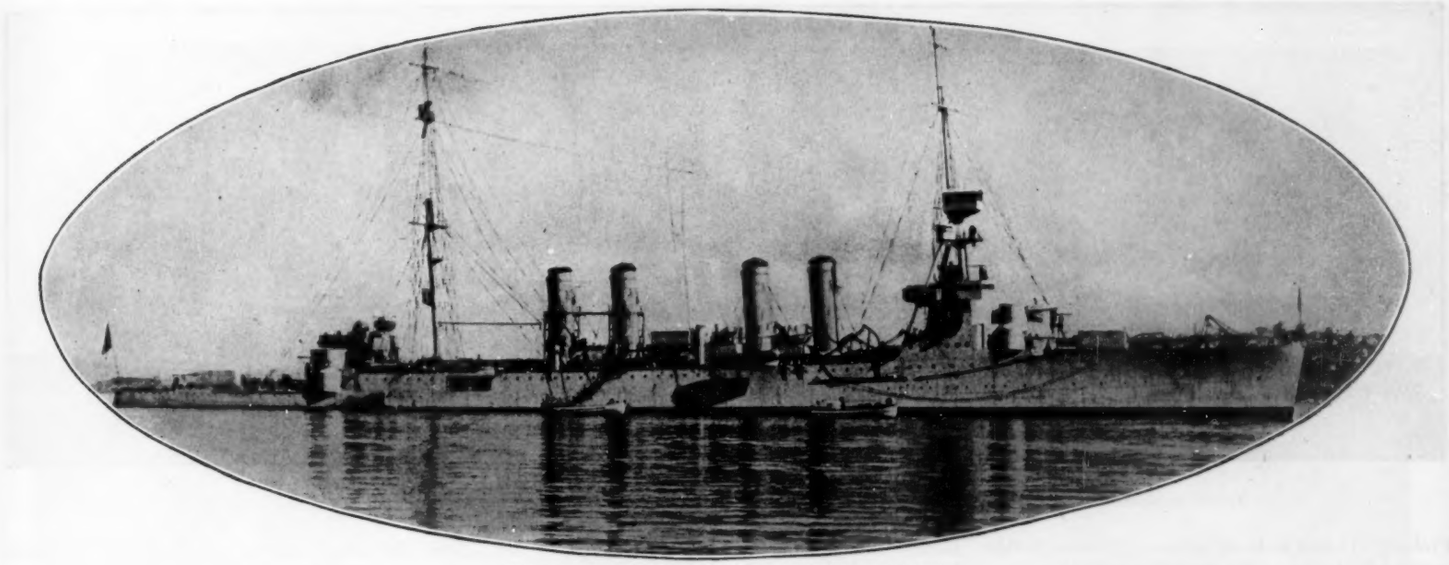
British Treaty cruiser, *Suffolk*. Speed, 34 knots. The standard displacement as set by the Washington Treaty is 10,000 tons, but this does not include any fuel or reserve feed-water, which will add another 1,500 tons. This will bring all Treaty cruisers up to 11,500 tons



Italian Treaty cruiser, *Trento*. Standard displacement, 10,000 tons; full load, 11,500 tons; length over all, 624 feet; beam, 67½ feet; mean draft, 19 feet. Guns: eight 50-caliber, eight-inch; twelve four-inch anti-aircraft. Eight 21-inch torpedo tubes in twin mountings. Speed, 35 knots



French Treaty cruiser, *Tourville*. Standard displacement, 10,000 tons. Length over all, 630 feet; beam, 63 feet; draft, 20 feet. Guns: eight eight-inch; eight 2.9-inch anti-aircraft; eight three-pounder anti-aircraft. Six 21.7-inch torpedo tubes in two triple mountings. Speed, 34 knots



UNITED STATES PRE-TREATY CRUISER, "OMAHA"

Displacement as completed, 9,000 tons. Speed, 34 knots. The Treaty cruisers will be 10,000 tons displacement, with a speed of 34 knots

The Treaty Cruiser—Is It Worth While?

High Speed and Heavy Battery Offset By Poor Protection

By Hector C. Bywater

THE standardized cruiser which the Washington Naval Treaty has brought into being is a ship nominally of 10,000 tons, but displacing at least 11,500 tons with fuel and feed-water on board; having a speed not less than 33 knots, and a main battery of eight-inch guns. Vessels of this type are now under construction for all the major navies of the world. The British program comprises 16 such ships; the United States proposes to build eight; Japan has four on the stocks; France, three, and Italy, two. Twenty-two cruisers of the treaty type are actually under construction, and many more will be laid down in the next few years, if current building plans mature. These figures seem to suggest that the type is favored by international naval opinion. The facts, however, point to the contrary. The treaty cruiser is being developed, not because of its inherent qualities as a fighting ship, but because circumstances have made it the recognized standard of cruiser power which no leading navy can ignore.

Practical naval students are alive to its defects; hence the nicknames of "suicide ships" and "tin-clads" which have been applied by some critics in England to the cruisers now being built there. The treaty cruiser is, in fact, the unwanted offspring of a diplomatic compromise. Certain American writers declare that British opposition at the Washington Conference to the scrapping of the "Raleigh" class cruisers, of 9,750 tons, resulted in the permissible displacement of future cruisers being raised to 10,000 tons, which was far above the average displacement of cruising ships then in existence. Moreover, since the "Raleighs" were armed with 7½-inch guns, the maximum gun caliber of future cruisers was fixed at eight inches. This story has never been confirmed, but it does offer a plausible explanation as to the strange action of the Conference in adopting such generous limits of tonnage and gun-power for future cruisers. It is, in any event, a singular fact that an international conference, convened for the purpose of limiting naval armament in every way possible, should have promoted the building of ships that are larger, more powerful and more expensive than the vessels of their type which were previously afloat.

The British "Raleighs," having been designed for the special service of hunting German raiders, were provided with a battery of unusual strength to enable them to deal swiftly and decisively with such enemies; and they were further endowed with a great radius of action. Hence their relatively large displacement. However, of the 18 new British cruisers that were laid down subsequent to the "Raleighs," three were of 7,100 tons, and all the others of 4,190 to 4,700 tons. Contemporary Japanese cruisers ranged from 3,500 to 5,600 tons. Hence the *average* displacement of cruisers in the pre-Conference period was not above 6,000 tons.

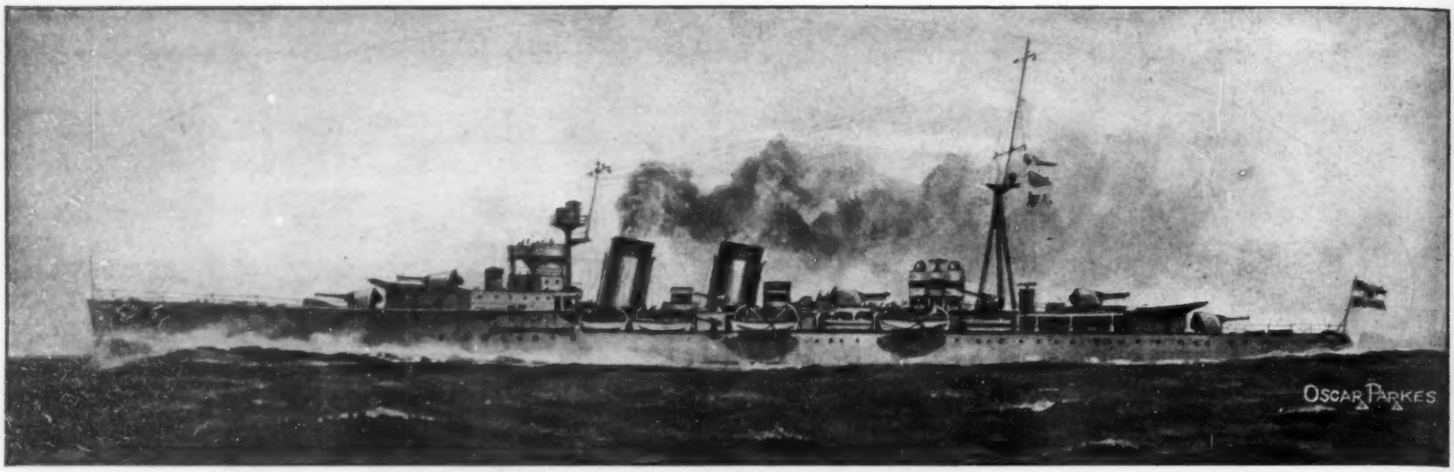
In deciding to increase this average by 4,000 tons, the Conference experts can hardly have foreseen the consequences of their act. The maximum tonnage limit has inevitably become, in practice, the minimum, for as soon as one power started to build 10,000-ton cruisers, the other powers were compelled, in self-defense, to follow suit. As a result, scores of ships that would ordinarily have remained effective for years to come, have been prematurely rendered obsolete, while the cost of cruiser construction has risen by at least 33 percent. Nor is this all.

Treaty Cruiser Not Adequately Armored

Previous to the Conference there were only 25 cruisers being built, ten of these being American, nine Japanese and six British—the latter representing the residue of war-time programs. Since the Conference, however, no fewer than 49 new cruisers have been laid down and authorized. Of these, 15 are British; 12, Japanese; nine, French; eight, American, and five, Italian. In the face of these figures it is impossible to deny that the Washington Treaty has tended to swell the volume of new cruiser construction instead of diminishing it. Since 36 of the 49 post-Treaty ships are of the 10,000-ton class, it is evident that this class will predominate.

The "standard" displacement specified in the Treaty is misleading, in that it does not include any fuel or reserve feed-water, two items which together may account for 1,500 tons. Hence the true weight of a Treaty cruiser as ready for sea is likely to be 11,500 tons, a figure approaching the displacement of many a pre-dreadnaught battleship. But, whereas, the old mixed-caliber battleship carried a large amount of defensive armor, the Treaty cruiser is signally deficient in this very important attribute of protection. Admiral von Tirpitz, who inspired the design of the German battle-cruisers present at Jutland, used to say that the first requirement of a warship was that it should remain afloat and keep its fighting equipment intact to the last moment. This principle was certainly embodied in all the German ships built during his administration. Such units as the *Goeben*, the *Seydlitz* and the *Derfflinger* came within measureable distance of the ideal of unsinkability. In the British battle-cruisers, on the other hand, hull protection had been sacrificed to speed and gun-power. No impartial student of the Battle of Jutland can doubt which of the rival theories vindicated itself in that engagement.

In the case of the Treaty cruiser, the naval designer is up against a baffling problem. He is asked, first of all, to provide for a speed of at least 33 knots, which entails great length and the installation of a very high-powered steam plant. He must further allow for a battery of not less than eight eight-inch, 20-ton guns, besides an adequate number of anti-aircraft pieces and torpedo tubes. Space and weight must also be reserved for a large fuel supply, and for the accommodation of some 800 officers and men. Even if the actual displacement of the ship be taken as 11,500 tons, it follows that, after all these requirements have been met, a very slender margin will be left for protective devices. Even a partial waterline belt of armor thick enough to resist shot of medium caliber will be out of the question. The ideal protection for such a ship would be a vaulted deck completely enclosing all the interior spaces and having a thickness of four inches over such vital parts as machinery and magazine spaces, but the weight would, of course, be prohibitive.



SPANISH PRE-TREATY CRUISER, "PRINCIPE ALFONSO"

Normal displacement, 7,850 tons; full load, 9,000 tons. Speed, 33 knots. Armor: 1½ to three-inch on sides; one to 1½-inch on decks

Probably the best that can be done is to work in thin horizontal plating on the waterline amidships, associated with light steel decks over the magazines, boilers and engines, but even at its strongest point this defense would be penetrable by the six-inch gun at medium range and by the eight-inch gun up to extreme fighting distance. It would, however, serve the purpose of discouraging the use of the large-capacity high-explosive shell.

The Treaty cruiser would still have insufficient protection even if the ships it had to meet in battle were armed with six-inch guns. But it must be prepared to encounter adversaries which are armed, like itself, with the eight-inch gun, a weapon discharging 260-pound shells with a velocity of 3,000 foot-seconds and a muzzle energy almost thrice that of the six-inch piece. It has an effective range of at least 18,000 yards. The latest Elswick eight-inch 50-caliber model is credited with a firing rate of five rounds a minute, but in stress of action, four rounds a minute per gun from twin-mounted guns probably represents the highest rate attainable. A Treaty cruiser should thus be able to discharge 32 eight-inch shells a minute, making a total weight of 8,320 pounds.

The artillery power of these ships is, indeed, extremely formidable, a fact that brings into sharper contrast their shortcomings in the matter of protection. The average battleship, though presenting a big target, is able to endure a great deal of hammering without being placed *hors de combat*, because her vital parts are behind stout armor, and projectiles that hit her in other places would be unlikely to inflict fatal injury. But the Treaty cruiser is in a very different category.

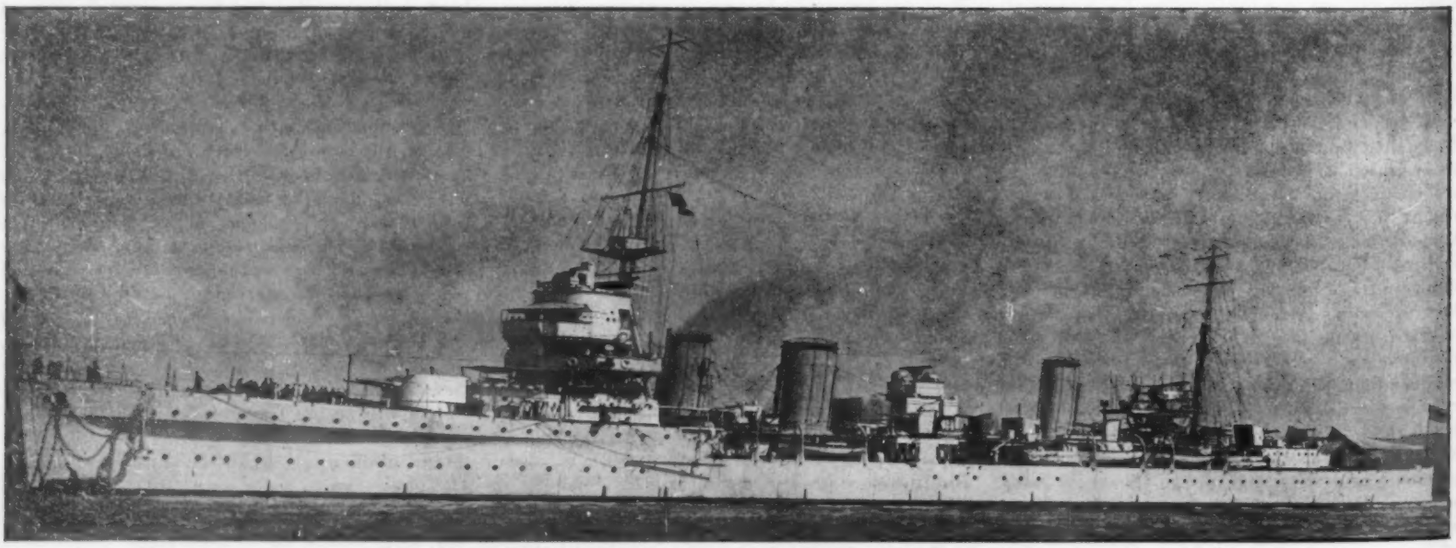
Diagrams of the French *Duquesne*, a typical ship of this class, show that more than four-fifths of the total length of hull is crowded with magazines and machinery. Therefore, a projectile striking the hull anywhere save at the bow or stern would be liable to cause severe, and possibly fatal, injury. The *Duquesne* herself is reported as having 1½-inch armor on the sides and the same thickness on the gun turrets. It is doubtful whether this plating would be proof against the splinters of an eight-inch shell; it is utterly useless as protection against direct hits even from small-caliber guns.

Vulnerability to Torpedo Attacks

As for the underwater protection of Treaty cruisers, the opinion of Sir George Thurston, a well-known British designer, may be quoted. Writing last year in "Brassey's Naval Annual," he said: "The interior of such a cruiser is so fully occupied by boilers, machinery, and magazines that it is not humanly possible to provide by bulkheads, watertight compartments, or other methods of underwater protection, immunity from torpedo or mine attack. Therefore, while in the interest of ordinary safety it is advisable to keep the vitals as far away as possible from the sides and to sub-divide to the fullest possible extent, it must be recognized that the explosion of a large mine or of a torpedo with a powerful warhead would, in the majority of cases, utterly wreck and destroy the vessel."

Every ship of war is exposed to the risk of destruction, but hitherto it has always been the practice, in vessels of major tonnage, to minimize this risk by allotting a substantial percentage of the total displacement to protective devices. This policy is a wise one from every point of view. A fighting ship that cannot survive a reasonable share of punishment is not worth her cost. It is difficult to escape the conclusion that the design of the Treaty cruiser is fundamentally wrong. These ships are simply speed machines, vulnerable to a degree unprecedented, and with the tactical advantage of powerful armament neutralized by inability to resist a single well-placed salvo. Yet each will cost from 12,500,000 to 15,000,000 dollars, and—what is of infinitely greater moment—the lives of 800 men will be involved in the fate of the vessel.

The Treaty cruiser is, in effect, a hybrid type, brought into existence under abnormal circumstances. Here, surely, is one section of the Naval Treaty that stands in urgent need of revision. It should be one of the aims of the next disarmament conference to limit the displacement of future non-capital ships to 7,000 tons or less, and their armament to six-inch guns.

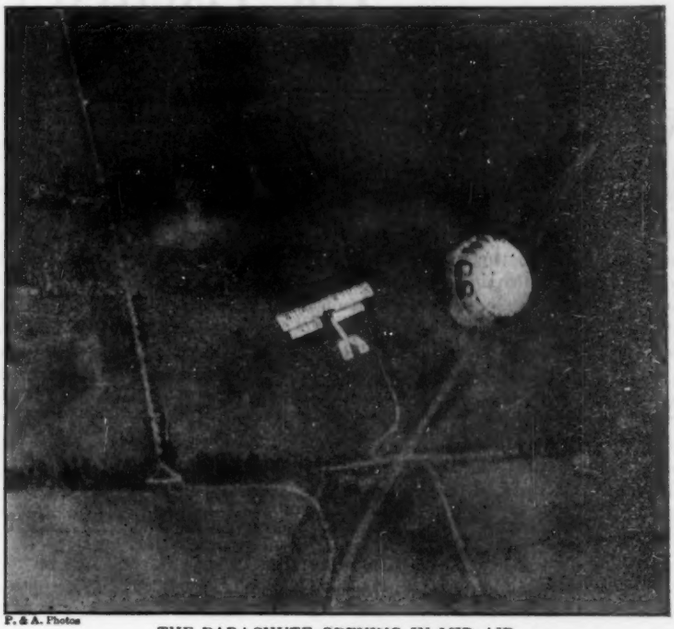


BRITISH PRE-TREATY CRUISER, "ENTERPRISE"

Normal displacement, 7,600 tons; full load, 8,800 tons. Length over all, 570 feet. Speed, 33 knots. Side armor, 1½ to three-inch; decks, one-inch

A DEMONSTRATION MODEL OF THE PARACHUTE

This illustration serves to depict the relationship between the parachute and the airplane which it supports, particularly as to the fastening between them



P. & A. Photos

THE PARACHUTE OPENING IN MID AIR

Dropping at an estimated rate of 38 feet per second, the airplane was brought to earth safely by means of the parachute shown in the act of opening

P. & A. Photos

JUST AFTER A SUCCESSFUL LANDING

Although the under-carriage was said to be slightly damaged in the initial test, all concerned expressed their hopes for the ultimate success of the device

P. & A. Photos

THE PLANE, THE PARACHUTE AND THE PILOT

This photograph shows the parachute piled on the fuselage after what is said to be the first successful landing of a plane by means of a parachute

Parachute Carries Airplane to Earth

The first landing of a plane, supported by a parachute, ever made in the United States, was reported recently. The pilot, R. Carl Oelze of the San Diego Naval Air Station shut off his motor at 2,500 feet altitude but, it is said, made no attempt at gliding. The plane landed in one minute and six seconds after falling at an average speed of 38 feet per second. The descent appeared rapid at first, but was checked as the parachute opened. The plane then swung from side to side, but as it approached the earth its descent became steadier. The plane and parachute settled to earth in a slight hollow, suffering some damage to the landing gear. The final speed at which the plane landed was estimated to be considerably less than the average speed. The application of the parachute to the support of the entire plane is the joint invention of Harry B. Doucett, Chief Aviation Machinist's Mate at the San Diego Naval Air Station and of H. R. Russell, maker of the so-called Russell parachute. Lieutenant P. D. Donnelly, also of the San Diego Air Station, predicted that the tests would lead to the design of aircraft in which the passenger compartment would be detachable, so that in the event of serious accident in the air, the pilot would be able to deliver the whole compartment safely to earth. In the experiment described, plane, pilot and equipment weighed about 1,800 pounds. The parachute weighed about sixty pounds and was 54 feet in diameter. The plane used in the test was specially rebuilt to strengthen the midship section of the fuselage which would receive the greatest strain as the parachute opened. The parachute was installed in such a manner in the fuselage that it could readily be disengaged by the pilot. It was designed to be carried back by the wind, then opened and swung upward by the air pressure until it occupied the position shown in the photograph of the model. A special cradle of steel and aluminum was built into heavy center wing struts. The size of the parachute was determined from previous experience, to give a landing speed of not more than twenty feet per second. As an extra precaution the landing gear was strengthened to withstand an unexpectedly severe landing shock. The experiment is undoubtedly interesting, but it cannot be said to be conclusive. In the most dangerous aerial difficulties, such as when the plane stalls a short distance from the ground and goes into a spin, there would be no time to use the parachute. At greater altitudes it is much simpler for the pilot and crew to jump in individual parachutes. But for commercial craft carrying several passengers unversed in parachute jumping the development is not without interest. We may expect to hear more of this device in the future.

The Excited States of Atoms

By Karl T. Compton
Professor of Physics, Princeton University

MANY of us who count ourselves still young remember the definition in our text books of chemistry, "Atoms are the indivisible constituents of matter." It is said that a young student, who had boldly suggested a possible subdivision of atoms to explain some phenomenon and was sharply reminded by Lord Kelvin that the very word atom is the Greek for indivisible, replied, "There you see the disadvantage of knowing Greek."

We now know that every atom is a complex structure, consisting of a positive electrical charge of known amount and a definite number of negatively charged electrons arranged around the positive charge, and probably moving in orbits like planets around a sun.

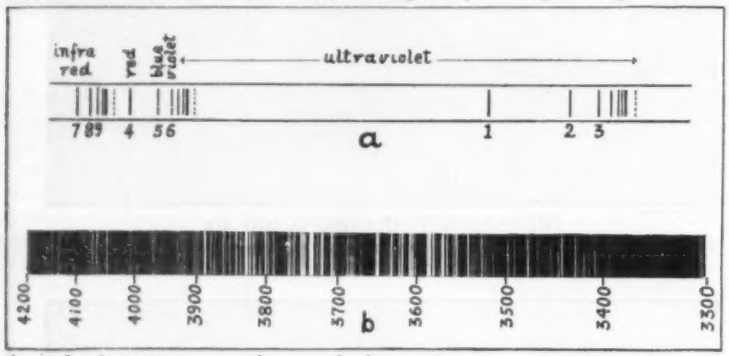


FIGURE 1

ABOVE: *(a). Diagram of spectrum of hydrogen showing series of lines 1, 2, 3, et cetera, in ultraviolet, series 4, 5, 6, et cetera, in the visible and near ultraviolet, and series 7, 8, 9, et cetera, in infra-red. The distances from the left are proportional to light vibration frequencies. Figure 1 (b). Portion of the spectrum of iron. The numbers are wavelengths in units of 0.00000001 centimeter. The extreme left end of the spectrum lies in the violet end of visible region*

Another old and rather deeply rooted idea is that an atom is an entity, possessing always the same definite specific properties. This concept, like that of the indivisible atom, has had to be discarded. We now know that every atom is capable of existing in an infinitely infinite variety of states which may differ markedly in chemical and physical properties.

A well established method of investigating any object is to stir it up and then see what happens. In dealing with atoms, which cannot be seen, this is the only available method of examination. All our knowledge about atoms has come through the finding of a consistent line of interpretation of what happens when matter (a complex structure of atoms) is disturbed in various ways. Only a few of the simpler and more striking effects of such disturbance can be discussed in this brief space.

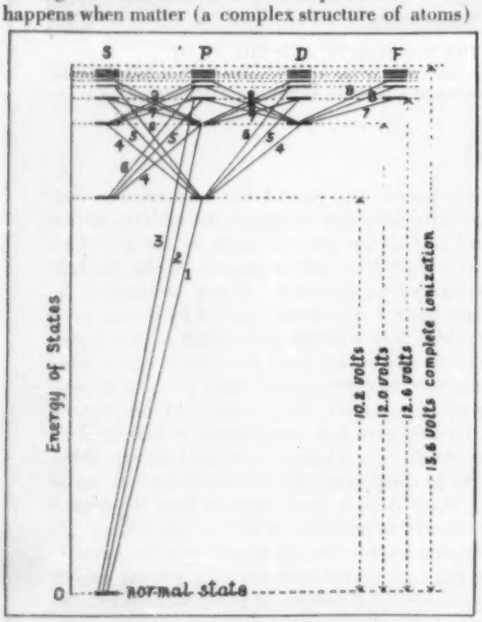


FIGURE 2

Grotrian diagram of the energy states of hydrogen

Most fruitful of all methods of studying atoms has been the examination of the light which they emit under various stimuli, together with the converse study of the kinds of light which they can absorb under various conditions.

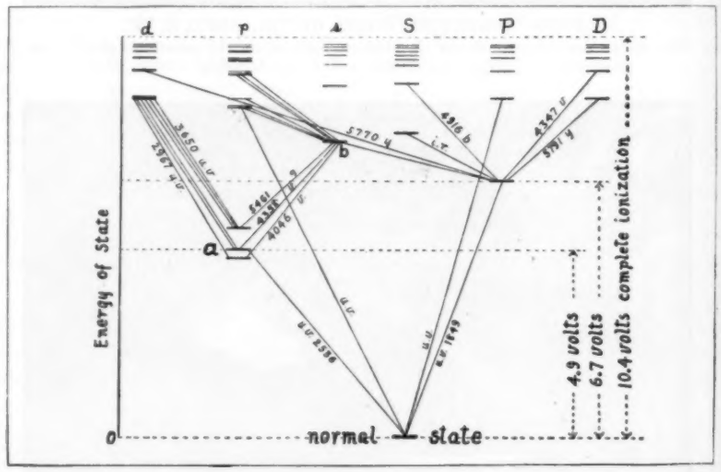
Light passing through a slit may be brought to a focus by a lens, so as to cast an image of the slit on a screen. If a transparent prism is interposed, the light rays are bent, different colors or wavelengths of light being bent differently, so that there are as many separate images of the slit cast on the screen as there are different colors of light in the source. If all wavelengths are present, as in light from an incandescent solid, these images merge into one another, side by side, and the result is the familiar continuous or rainbow spectrum. But if the source of light is a luminous gas, then only light of certain definite wavelengths is found to be present and there is a corresponding set of images of the slit, each in its own color and in a position on the screen which depends upon its wavelength. This set of colored images is the "spectrum" of the gas. If the screen is a photographic plate, the arrangement described above is a spectrograph—capable of giving a permanent photographic record of the spectrum.

The spectrum of a gas is an extraordinarily definite thing, absolutely characteristic of each particular gas. Some spectra are very simple; others are very complicated. Figure 1 (a) shows the simplest spectrum, that of hydrogen, and shows that the spectrum which the eye can see is only a small part of the entire spectrum which can be investigated photographically, or by other methods. Figure 1 (b) shows a small section of one of the most complex spectra, that of iron vapor.

The remarkable definiteness of the spectrum of each kind of atom at once suggests something very definite in the structure or behavior of the atom. These "somethings" are the "states" of the atom, and experiments of the sort to be described later show that light is emitted or absorbed by the atom only as it changes its internal structure from some one of these states to another. This can be illustrated by the so-called "Grotrian" diagram of hydrogen, Figure 2.

FIGURE 3

BELOW: *Grotrian diagram of energy states of mercury. Diagonal lines show transitions between states which produce prominent lines in mercury spectrum. Letters y, g, b, et cetera, indicate color; numbers indicate wavelengths*



The heavy horizontal dashes represent the possible states of a hydrogen atom and the vertical position, or level, is proportional to the energy contained by the atom in these states. The state of least energy, which we can take as the zero energy state, is the "normal" state of the atom, that is, the state in which all hydrogen atoms are found unless some source of energy is acting to increase their energy to that of the other states, which are called the "excited" states. The differences between these states are known to be due to differences in the arrangement of the electrons which exist outside the nucleus, probably in the shape and size of their elliptical orbits. In a hydrogen atom there is only one electron, so that each of these states corresponds to some one of the possible orbits of this electron. In the normal state this orbit is very small, the electron remaining always close to the nucleus (about one hundred-millionth of a centimeter from it).

The states of larger energy correspond to larger orbits, and the increased energy is due to the work done in pulling the electron to a greater distance from the attracting nucleus. The dotted line at the top is the state in which the orbit is so large that the electron flies away and is lost to the atom. The most striking feature of the atom is the existence of these discrete states or orbits, instead of all varieties of orbits as are possible in gravitational motions.

Every change of an atom from a state of higher to a state of lower energy is accompanied by the emission of light whose vibration frequency (the reciprocal of the wavelength) is directly proportional to the difference in energy of the two states. Thus, if W_2 and W_1 are the energies of the two states, the change from state 2 to state 1 gives rise to the emission of light of frequency ν given by $W_2 - W_1 = h\nu$ where h is known as Planck's constant. Thus we see that in changing its state, an atom radiates in the form of light the energy which it loses in the change. If it changes from a low to a higher energy state, the corresponding amount of light energy of the right frequency must be absorbed from the agency which causes the change.

With this explanation, it may be seen to be pos-

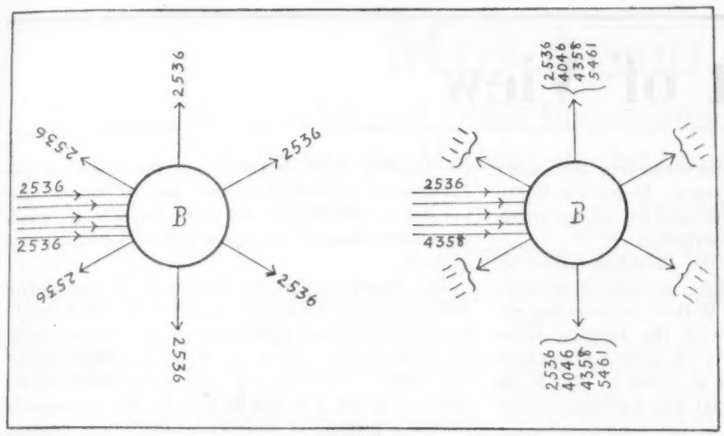


FIGURE 4

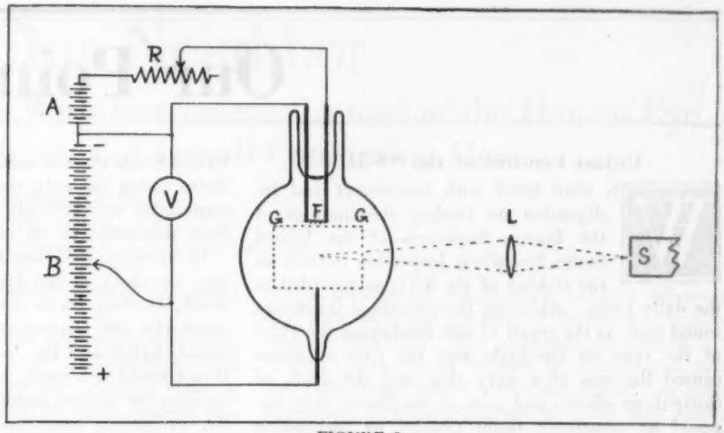


FIGURE 5

sible to unravel a complicated spectrum so as to find out just what energy states must be assumed to exist in the atom in order to account for the observed spectrum. For instance, the spectral lines marked 1, 2, 3, 4—in Figure 1 (a) are due to transitions between energy states as indicated by the correspondingly numbered diagonal lines in Figure 2. The notation S, P, D, F, et cetera, has a significance which is most simply stated by saying that, usually, only those changes of state occur which are between adjacent columns, that is, from S to P, D to P, P to D, et cetera, but not S to F, et cetera.

Figure 3 shows a portion of the similar Grotrian diagram of the states of mercury, with a few of the changes of state which produce the prominent lines in the mercury arc spectrum designated by y, g, b, u.v., and so on, according to the color or ultraviolet character of the light emitted in the change. The numbers correspond to wavelengths of the light in units of one hundred-millionth of a centimeter.

Atoms Absorb and Reradiate Light

We now pass to another phase of investigation by which the validity of this energy state explanation of spectra has been placed on a direct experimental basis. From among numerous types of experiment, two of the simplest and most significant are the following:

(1) *Optical Excitation.* (Figure 4.) Ordinary mercury vapor, for example, can only absorb light of wavelengths corresponding to transitions from the normal state, as shown by the various spectral lines in the series 1, 2, 3, et cetera, and 4, 5, 6, et cetera, in Figure 3. To all other light the normal vapor is transparent. Suppose that a bulb containing mercury vapor is placed in a beam of ultraviolet 2536 light (that is, light having a wavelength of 2536 ten-millionths of a millimeter or Angström units), coming from any convenient source such as a nearby mercury arc. Some of the mercury atoms, in absorbing this light, are "excited" to the state *a*, whence they sooner or later revert to the normal state and re-emit the 2536 light. Thus the mercury vapor absorbs 2536 light and reradiates it in all directions. This reradiated light, called "resonance radiation," has been extensively investigated by R. W. Wood.

If mercury vapor is illuminated by violet light 4358 nothing happens, since the mercury atoms in the normal state cannot absorb it. But if illuminated *simultaneously* by 4358 and 2536, then there is emitted by the vapor light of the four wavelengths 5461, 4358, 4046 and 2536 as a result of the following process: first, mercury atoms are excited to state *a* by absorbing 2536 light; second, these atoms now in state *a* are able to absorb 4358 light and some of them will do so, yielding excited atoms of state *b*. From states *a* and *b*, there are possible the transitions to lower energy states which emit the four spectral lines mentioned above. In a similar way the various energy states may be optically excited, one by one, and the Grotrian diagram verified step by step.

(2) *Excitation by Electron Impact.* Another way of supplying energy in definite amounts to atoms is to bombard them by electrons whose kinetic energy is controlled in the following manner:

In a glass or quartz bulb a filament F is heated to incandescence by current from a battery A, and in this condition it emits electrons which are drawn to a perforated gauze G by applying between F and G a voltage V from a battery B. Many electrons pass through the openings in the gauze and collide with atoms of gas. If the voltage V is large enough, this bombardment suffices to change the atoms from their normal to their various excited states, and in returning to their normal states they emit a spectrum, which serves to identify the states to which they have been changed by the bombardment. This spectrum is examined by concentrating the light

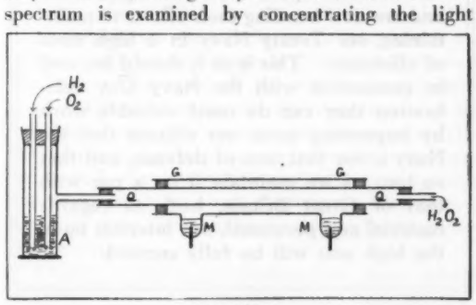


FIGURE 6

which is produced on the slit of a spectrograph, by means of a lens L.

The experimental procedure is to increase the bombarding voltage V in small steps, and examine the spectrum at each step. In case the bulb contains mercury vapor, for example, no light at all is produced by the bombardment if V is less than 4.9 volts. At this voltage the line 2536 appears in the spectrum, but no other line appears (except faintly, due to complicating phenomena) until the voltage is increased to 6.7 volts, at which the line 1849 appears. Similarly the other lines appear one by one as the voltage is raised until, at 10.4 volts, the entire arc spectrum is present.

Now the kinetic energy of an electron which has moved through 4.9 volts, is easily calculated, and when this is divided by Planck's constant h we have exactly the frequency corresponding to 2536 light. Similar calculations give the other lines of the mercury spectrum, and some of these are indicated to the right in Figure 3. Thus we have made a direct measure of the energies of the various states of mercury and verified the energy state diagram which was suggested to interpret the spectrum. Similar studies of other gases and vapors have been made.

A series of brilliant investigations, principally by Franck and his pupils in Göttingen, has disclosed the fact that the energy stored up in excited atoms may be used in other ways than to produce light, and this discovery will doubtless have wide applications in chemistry and in the art of illumination. A single illustration, taken from work done in Princeton by Professor Taylor and his collaborators, will serve to suggest the possibilities of this discovery in chemistry.

It is well known that hydrogen, H_2, and oxygen, O_2, when mixed, do not combine unless ignited, and then they combine with explosive violence to form water, H_2O. But they may be otherwise united through the agency of excited atoms as follows:

In Figure 6, QQ is a quartz tube. A glass tube CG is provided with mercury electrodes MM and evacuated. Oxygen and hydrogen gases are made to stream through the quartz tube and a mercury arc is maintained in the surrounding tube. Although the oxygen and hydrogen in the quartz tube are intensely illuminated by light from the mercury arc, they are unaffected thereby since they are transparent to those wavelengths of light supplied by the mercury arc, and thus absorb no energy from it.

What Is Photocatalysis?

If, however, the oxygen and hydrogen are bubbled through mercury, as at A, so that they carry along with them a little mercury vapor into the quartz tube, the gases emerge combined in the form of hydrogen peroxide, H_2O_2. The action is this: the mercury atoms within the quartz tube absorb the 2536 light from the mercury arc and are changed to the excited state *a*, Figure 3. If a mercury atom while in this excited state collides with a hydrogen molecule, its energy may be transferred to the molecule and is sufficient to split this molecule into two separate atoms. In this atomic state the hydrogen atoms are able spontaneously to start the reaction which leads to the production of hydrogen peroxide. The mercury vapor emerges from the reaction unchanged.

This "photocatalytic" action is typical of many others, such as that of chlorophyll in leaves to render sunlight effective for plant growth, and that of "sensitizers" in photographic work. The discovery of the reason for these catalytic actions will doubtless expedite their applications to many useful purposes.

It is realized that so brief a survey as this cannot be complete. It is hoped only that it may serve to disclose one direction of recent research in this important branch of atomic physics and to suggest the point of view, the methods and the possible applications of this work.

Our Point of View

Unjust Censure of the "S-51"

WE were filled with amazement and indignation on reading the findings of the Boston inspectors of the United States Steamboat Inspection Service on the sinking of the *S-51*, as recorded in the daily press. Although the steamboat inspectors found that, as the result of her disobeying the rules of the road on the high seas, the *City of Rome* caused the loss of a navy ship and the death of thirty-three officers and men of the Navy, they imposed an amazingly slight penalty by suspending the captain and the mate of the law-breaking ship for only nine months. If the extent of the penalty is to be taken as a measure of the gravity of the offense, these steamboat inspectors cannot blame the public if it believes that they have a very slight regard for the sanctity of the International Rules of the Road on the high seas.

This is bad enough; but when these gentlemen proceed to cast a slur upon the ill-fated officers of the ship who were sent so summarily to their death, they are insulting the Navy of the United States and are doing grave dishonor to heroic men who died in the faithful performance of duty. Just listen to this:

"We are satisfied," say the inspectors, "that had the officers on the *S-51* been under the jurisdiction of this service, action would have been taken against their license had it been possible." There is a suggestion of spite and a very strong flavor of gross impertinence in this statement. Whatever the steamboat inspectors may think of the International Rules, the officers on any Court Martial or Court of Inquiry held in our Navy have and always will have for these rules a most profound regard. And judged by these rules, not only was the navigation of the *S-51* absolutely correct, but if she had changed her course or in any way maneuvered to avoid the *City of Rome*, as the steamboat inspectors suggest she should have done, her officers would have been guilty of a direct breach of the law—as we shall now show.

Article XIX of the International Rules reads: "When two steam vessels are crossing, so as to involve the risk of collision, the vessel which has the other on her own starboard side," in this case the *City of Rome*, "shall keep out of the way of the other."

Article XXI. "When by any of these rules one of two vessels is to keep out of the way, the other," in this the *S-51*, "shall keep her course and speed."

When the ship which is obeying the rules sees that the ship which is breaking them is coming so close that the risk of collision is great, then and only then is she justified in not keeping "her course and speed." When the *S-51* saw that the *City of Rome* was making collision imminent, she endeavored to turn away, for when she was raised her rudder was found to be swung over to starboard.

The International Rules of the Road are based upon centuries of experience, and they constitute one of the greatest safeguards to life at sea. If the Steamboat Inspection Service of Boston takes upon itself to suggest that the navigating officers of ships should do anything else but most rigidly observe these rules, we think it is about time that this local steamboat inspection service be itself subjected to very drastic inspection.

Six Years' Oil Supply Left

THE preliminary report to President Coolidge of the Federal Oil Conservation Board, recently made public, says that in the proved oil sands of the United States there is sufficient oil to keep the United States going for only six years. Hence the Board emphasizes very strongly the need for taking immediate measures for oil conservation.

In creating the Board, the President called in four members of his Cabinet: namely, Secretaries Work, Hoover, Davis and Wilbur, representing respectively the Departments of the Interior, Commerce, Labor and the Navy. A more authoritative Board could not exist; but in order to give to its findings the highest industrial and financial authority, invitations were sent to the large producing, refining and marketing companies of the country, who gave full cooperation in securing the required data. Moreover, some of the most expert engineers, geologists and owners read papers at the various meetings of the Board, that showed an evident desire to bring out all the facts and make a frank statement of opinion. Hence the report, which is signed by the four cabinet members above mentioned, is a document of the very highest authority. In these days of propaganda, it is refreshing to receive a document dealing with a great national problem, whose statements may be accepted without a shadow of a doubt as to their truth and impartiality.

The findings are fully in keeping with the facts which the Scientific American has brought out, during the past few months, in its articles on the oil industry. The report states that the total present reserves in pumping and flowing wells is estimated at 4,500,000,000 barrels. But in spite of this vast reserve, it is estimated that, theoretically, the supply of oil cannot be estimated to meet the demand of the United States for more than six consecutive years.

Perhaps the most important part of the report is that which deals with unrestricted drilling and the great waste which attends it. The facts which we unearthed in our own investigation of the problem are fully indorsed. In some cases indeed they are exceeded, as for instance when we read that in the Cushing field in Oklahoma the waste of gas amounts to 300,000,000 cubic feet of natural gas per day or 100,000,000,000 cubic feet a year, which the report affirms is the equivalent of 5,500,000 tons of coal.

The Board emphasizes the need of cooperative drilling; but it evidently considers that this should be done by mutual agreement among the leaders of the industry and not as the result of direct legislative action. With this policy we are in entire agreement; although it would be well for the oil industry to realize that unless unrestricted drilling is stopped, Congress, in sheer defense of one of the nation's most valuable war reserves, will be under the necessity of taking direct control by legislative enactment.

Maintain the Treaty Navy

There is one outstanding policy for the nation to follow with regard to the United States Navy, and that is to furnish sufficient appropriations to maintain the Navy in the rank assigned to it by the Treaty of Washington. This rank is determined by the formula "5-5-3" as applied to the three leading navies—our own, and those of Great Britain and Japan. Save for the annual outburst of our venerable friend, Rear Admiral Rodgers at the Williamstown gatherings, our naval officers have accepted the Washington ratio and are now bending their efforts to maintaining our Treaty Navy in a high state of efficiency. This is as it should be, and in connection with the Navy Day celebration they can do most valuable work by impressing upon our citizens that the Navy is our first arm of defense, and that so long as we maintain it on a par with that of Great Britain, both as regards material and personnel, our interests upon the high seas will be fully secured.

Alfred Ely Beach

SEPTEMBER the first of the present year marked the centennial of the birth of Alfred Ely Beach, who for nearly half a century was the editor of the Scientific American. Although he was but nineteen years old, young Beach was not without antecedents and experience in such literary work, for he was a nephew of Ben Day, the founder of the *New York Sun*, and was also the son of the second owner of that paper; furthermore he had seen a few years of active work on his father's staff.

Young Beach's life opportunity came in 1846 when he learned that the Scientific American was for sale and he immediately wrote to his former schoolmate, Orson D. Munn, asking him to come to New York with such capital as he could furnish and share in the new and promising venture. Young Munn acted quickly, for he at once gave up his job, married, and came to New York with his bride. Thus was formed a partnership which lasted for fifty years. The Scientific American, under the care of its young owners became the Mecca for inventors. Beach possessed a keenly inventive mind and was always ready to advise and assist gratuitously anyone who was working upon a promising device. Hence Munn & Company were the early confidants, advisers and friends of some of America's most distinguished inventors. The writer has heard Mr. Beach, in his later years, tell of one of Edison's visits to the office, when the inventor placed a small box provided with a crank upon the editorial desk. At Edison's request Beach turned the crank, when he was startled to hear a voice issue from the box exclaiming, "Good morning, sir, how are you?"

Mr. Beach was himself a prolific inventor and among his own inventions, perfected when he was not yet of age, was a typewriter which embossed the letters on a paper tape for the blind to read.

Learning that the British Postmaster General was developing a scheme for transmitting the mails through pneumatic tubes, Mr. Beach devised a tube and carrier which would not merely transmit mail, but would automatically collect it from the street letter boxes *en route*. Then, in 1869, he obtained a charter to build such a tube from the Liberty Street Post Office to the Harlem River, but with the proviso that there must be no ripping up of the street. This was never built; but to meet these conditions he devised a hydraulic tunneling shield and by its use he built a full-sized experimental tunnel beneath Broadway from Warren Street to Murray Street. This tube remained in existence, though blocked up, until the construction of the B. M. T. Subway a few years ago. These and other inventions of less importance show that, like Seldon, Mr. Beach was a pioneer inventor.

Mars Again Our Neighbor

Recent Photographic and Other Investigations With Instruments Instead of the Human Eye Confirm the Majority of the Conclusions of Lowell Concerning Mars

By Henry Norris Russell, Ph.D.
Professor of Astronomy, Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

THE principal astronomical event of November this year is undoubtedly the opposition of Mars, which occurs on the fourth at 4 A.M., Eastern Standard Time.

All through this month, as through October, the planet will be the object of intensive studies of varied sorts, for the opportunity which the occasion affords is a good one. Although not quite so close to the earth as in 1924, Mars is more favorably placed for northern observatories—being in Aries—and some 15 degrees north of the celestial equator. His distance, which at his closest approach on October 27th is 42,500,000 miles, increases gradually and, by the end of November, reaches 52,000,000 miles. Even so, he is closer for almost the whole month than he ever comes at an average opposition. This makes him a brilliant object. His greatest brightness at the beginning of the month corresponds to the stellar magnitude – 2.1, that is, he is of nearly twice the apparent brightness of Sirius and just about equal to Jupiter. By the end of the month he has lost half his light, but he still exceeds all the stars, except Sirius. His northern declination makes him rise early—at 5:10 P.M. on the first, and more than two hours before this on the 30th, and he is visible practically all night.

With the telescope, Mars presents a disk which is fully 20 seconds in diameter at the month's beginning and nearly 17 seconds at its close. With a magnifying power of 100, he looks larger than the full moon—although this would not be recognized by the novice, since objects seen directly in the sky impress the eye as being a good deal larger than those which, when viewed telescopically, are of equal angular subtense. With good atmospheric conditions, considerable surface detail should be seen on a disk of this size even with telescopes of moderate dimensions.

New Light on Mars

The season on Mars during this month corresponds with February upon the earth—that is, the southern hemisphere is in the latter part of summer, so that the south polar cap—which alone is visible to us since the north pole is turned away from the earth—should be far advanced in its shrinkage and should appear as hardly more than a little white dot, if indeed it has not wholly vanished.

Mars is the object of so much, so general and so reasonable an interest that it may be appropriate to review our present knowledge and our hopes for this year's observations, even though most of what is said here has been said before in these columns at various times.

For many years, the study of Mars proceeded mainly by means of visual observation of the details of its surface. These showed, more than 200 years ago, the seasonal changes of the white polar caps and the existence of permanent darkish and greenish areas mottling the planet's ruddy surface. The work of the last 50 years added the recognition of the faint, narrow and elusive "canals" (fine almost linear markings which cross both the light and dark areas), seasonal changes in the intensity and hue of some of the dark markings, and also led to the detection of occasional white spots lasting for a very few days at most, which strongly suggested clouds.

The theory that the polar caps were snowfields, that the dark regions were areas of vegetation and that the canals were narrow plant-covered areas in the reddish deserts, irrigated by water courses natural or artificial, gave a consistent account of these phenomena, but in spite of this, there was much scepticism about it, for no satisfactory proof of any part of it was forthcoming at a time when the eye was the only "instrument" employed.

Within the last few years, however, the Martian problem has taken on quite a new aspect, for new and powerful methods of observation have been applied. Photography—with steadily increasing success as its technique improved—has obtained direct evidence, free from any question of personal equation, of the reality of the more prominent canals, the seasonal changes of the dark areas and the existence of occasional clouds. The use of color-sensitive plates with screens of different colors, has brought out a wealth of facts, not yet fully interpreted, which show that the contrast of the various features is greatest in red and least in violet light, and suggest strongly the existence of an atmosphere upon Mars, less in quantity than on the earth but still considerable.

Animal Life May Exist

Still more striking are the radiometric observations, which not merely detect the heat which the planet sends us, but make it possible to obtain a fairly good estimate of the surface temperature. Two independent groups of observers agree on the conclusion that the temperature at noon in the Martian tropics throughout the year and at the poles at the end of summer, rises well above the freezing point—probably to about 50 degrees, Fahrenheit—while at night, it must be far below freezing even on the equator.

Finally, spectroscopic studies have given definite evidence that both oxygen and water-vapor are present in the atmosphere of Mars—although in much smaller quantities than on the earth.

This long series of important investigations speaks on the whole very strongly in favor of the theory of Martian conditions which was developed by visual observers. The determinations of temperature make it practically certain that the polar caps are really composed of frozen water—and not of some other chemical substance. The spectroscopic observations confirm this, and the presence of oxygen makes it appear more likely than not that vegetation exists on the planet; for the existence of green plants which take up energy from sunlight, decompose carbon dioxide and liberate oxygen, appears to afford the best way of accounting for the presence of this chemically very active gas in the planet's atmosphere.

Granting this, the great question of the existence of life on Mars is solved, for plants are just as much alive as animals.

Of the main points raised by such students as the late Dr. Percival Lowell, the majority appear now to be well on the way toward settlement, in a manner favorable to his ideas. The most striking of all his conclusions—the sharply geometrical character of the network of canals, with Lowell's inference that they were the product of intelligent activity, remains unsettled. The drawings of various observers appear to be affected by complicated personal equations which make the results curiously dissimilar, and unfortunately even the best photographs are not fine-grained enough to reveal such delicate details on such small images as those of the planet must needs be.

If vegetable life exists on the planet, as seems fairly probable, animal life may exist. The latter could not do so otherwise. But we appear to be far from having any unquestioned evidence that it does.

Despite the great advances resulting from the Martian observations of 1924, much still remains to be done. The radiometric observers—profiting by previous experience—should be able to tell us much regarding the way in which the planet's surface temperature varies during the course of the day, and with the progress of the seasons; and certain puzzling data obtained at the last opposition, which indicated a very low temperature of about – 70 degrees Centigrade for the polar cap itself, may this time be explained.

The photographic observations will carry their permanent record of the appearance and changes of the dark markings later into the Martian season than was possible two years ago. The work with color screens bids fair to be especially interesting. Professor Wright at the Lick Observatory, found in 1924 that the images of the planet obtained with violet light, were distinctly bigger than those photographed with red light—using a reflecting telescope, so that the two ought, theoretically, to have been of the same size.

What the Astronomers Are Doing

Does this mean that Mars has an extensive atmosphere which reflects violet light but not red? Or is the difference of size a photographic effect, due to different properties of the various sorts of plates which were employed? This autumn's observations are going far towards settling the matter.

When the planet has moved on and the thousands of color photographs of it have to be interpreted, more work will be in order—photographing terrestrial landscapes, preferably in arid regions to study the appearance of snow clouds, rocks and vegetation, when they are viewed through various thicknesses of air and photographed with the color screens used in observing Mars.

The spectroscopists, too, will be busy repeating the tests for atmospheric oxygen and water vapor, and perhaps will seek to determine whether there is more of the latter close to the diminishing polar caps than after the snowfields have disappeared.

Finally, the visual observers will still be busy doing the kind of work they have previously done.

Here is a long programme of interesting work, and we may be assured that our knowledge of the planet will be materially advanced at this opposition. It seems doubtful whether the remarkable advances of 1924 can be matched, but in any case, there ought to be things worth reporting—not next month, but in a year or so, when the task of reducing and discussing the observations comes to an end.

The Antiquity of Man in America

Who Were the First Americans? Whence Came They?

By Harold J. Cook

IN the Scientific American for July, 1926, appears a splendid article by Dr. Ales Hrdlicka, anthropologist of the United States National Museum, on "The Race and Antiquity of the American Indian." It is probable that no one living is better qualified to discuss in detail the comparative racial and physical characteristics of the American Indian, particularly with reference to the skull and brain.

It is but natural that a man's opinions should be influenced by his training and that his point of view should be correspondingly affected. But only when all types of competent evidence are properly weighed and evaluated can a comparatively true solution of the problem of the antiquity of man in America with a proper perspective be reached. It is not the intention in this article to introduce in any sense a controversial spirit, but in fairness to other branches of science we must review both sides of the question.

In Dr. Hrdlicka's interesting article we have considered from the anthropological angle man's antiquity in America. Let us now view some of the geological and paleontological evidence. Here is a great field of important data that is too sound and definite to be ignored. True, all human remains so far found in America appear to have a general racial homogeneity and to lack radical differentiation. On the other hand, we must not lightly discard evidence by which it appears that man in America antedates many previous calculations.

If we assume that because primitive Neanderthaloid or other races occurred in Europe in Pleistocene times, we must find here a similar sequence in order to prove that man had reached America by glacial times, we are presupposing conditions that no one yet knows. It is entirely possible that the "Indians" who have inhabited America have changed very little structurally and physically in many thousands of years. As any comparative anatomist familiar with the ancient life of the world knows, many races of vertebrates have at times remained little changed through millions of years, while through other long periods the rate of progressive change or evolution has been marked and rapid. Some branches of certain families have reached a given stage and then seemed, structurally speaking, satisfied to hold

WHERE THE EVIDENCE WAS FOUND

Stone lance points made by human hands were found with and under this bison skeleton discovered in solid rock of Pleistocene age. This specimen from Texas is on exhibition in the Colorado Museum of Natural History, Denver

HAROLD J. COOK

The author of this article is honorary curator of paleontology at the Colorado Museum of Natural History

that condition with little alteration during periods when other branches of the family were undergoing radical changes. The evidence that this has occurred is well known to vertebrate paleontologists and it is not necessary to go into the possible and probable controlling factors. As a result, we now know that we must not stress anatomical features to the exclusion of other lines of pertinent evidence, for, while valuable, they are not in themselves conclusive. Unless there is an agreement it must follow that some evidence is not being properly interpreted.

Mere Facts May Spoil Good Theories

It seems probable that most, if not all, of our known American Indian stock has reached this country from, or via, Asia, whatever their original abode. This has occurred at times when land conditions existed which were more propitious to such migrations than exist at this time. No one knows just what these land connections were, save in a very general way. A slight emergence of the present Bering Straits region would suffice. Climatic factors have, of course, been active in influencing habitat and migrations in the past as they do at the present. One who is not familiar with geology cannot appreciate what tremendous and fundamental fluctuations of climate the earth has undergone. We have no reason to believe that such changes have ceased, although generally their pulses run slowly, judging by the evidence in the rocks. If we may question how man could have reached here during glacial times, we may in the same breath and with equal propriety ask how the bison could have reached here in glacial times! Likewise other animals which we have good reason to believe are Asiatic migrants. If such animals could live and migrate, so could nomadic man, as is well demonstrated in recent times. There is much that we do not know about glacial and interglacial times, especially in great areas in America where the ice sheets did not extend, and it is well not to be too certain and too dogmatic about what could and could not have been, until all available evidence is carefully weighed and studied.

From known evidence it appears extremely likely that in recent geologic times, migrations from Asia into America, of both animals and men, have been in the nature of successive waves and in part, rather long drawn out dribbles instead of a single migration period. Consequently, among human migrants we would expect to find elements of various more or less related and unrelated Mongolian, Tartaric or other Asiatic stocks represented in America. It is well to recall that we have almost no "pure" human racial stocks, and particularly is this true on the major continents. With every possible degree of hybridism present, elisions and physical characters and blending are the almost certain result. This seriously complicates the problems that face the anatomist who attempts to draw broad conclusions on anatomical evidence alone and makes results far less certain.

Dr. Hrdlicka makes the statement that—"The Indian is free from characteristic odor." This is a mistake, as anyone with active olfactories, familiar with the American Indian, knows. The Indian has a pronounced racial odor, easily told from other races, as the writer knows from lifelong personal contact with him. The odor is so pronounced that, as early western army people or pioneers have frequently testified, many army mules and horses would snort and become terrified when Indians were near and up wind from them but out of sight, especially at night, thus giving the alarm that Indians were about when not otherwise suspected. I, personally, have seen this and have repeatedly heard similar testimony from unquestionable sources. Likewise, many early Indian horses would show great fear of a white man but pay no attention at all to Indians.

The writer is informed by a well-known authority, who has spent years among the Eskimos and has used them as models, that they have a marked racial odor, distinct from the Indian; and that the Eskimos from North Greenland do not have a dark or swarthy skin, as do those of South Greenland but, where they are not tanned, have a clear white skin, as fine as that of the blond Teutonic races.

When we observe the many Indian and Eskimo stocks from the Arctic to Tierra del Fuego, great differences can be observed, as well as many characters in common, so that it is quite as possible to pick wide differentiation among them as close homogeneity, depending upon which characters the observer may select and stress. It is certain that much work must yet be done on this subject by men of broad interests and wide training—men who will

EVIDENCE OF THE EARLY AMERICAN

These stone lance points, or large arrow points were found buried in the under side of the bison, in the undisturbed Pleistocene rock. The remarkably fine workmanship is much superior to the later cultures in the same region

approach its problems free from preconceived notions and who will weigh and evaluate all evidence found in all fields of research without bias.

It is not apparent to the writer that man, if he existed here in glacial times, would have been here, perforce, in great numbers, as has been suggested. That is possible, or even probable, but is by no means to be taken for granted without proof. Certainly such a statement is without foundation as a basis of argument as to man's presence in America at that time, though it is an interesting conjecture. As to man's "traces on the road" in eastern Asia or northern and western America, it is well to remember that these great regions are hardly scratched even yet by the hand of the scientist who understands what he finds when he finds it. Splendid work, sure to show results, is at present in progress in both Asia and America, but even this is a small beginning in a great field.

Why Early Man Left So Little Evidence

To the untrained person, or the person trained only in one field, it is difficult to grasp the magnitude and breadth of the evidence that is yet to be found and studied, and when one considers the handful of living men who are really doing such work, the wonder is that we know what is now known, and not that we do not yet have in our card indexes a record of all the desirable evidence. Every year, fortunately, is adding to this wealth of accurate knowledge. It is the proper business of the true scientist to search out this evidence and to follow where it leads, not to try to prove or disprove theories—interesting and instructive as they may sometimes be as pets.

Owing to the character of most of the deposits of glacial age that are known in America, and given a nomadic people such as our modern plains Indians who built no permanent abodes, developed no marked shell or bone heaps, and who "buried" their dead in trees, on scaffolds, or under some cliff covered as a rule only by a few rocks or cacti (in any event in such a manner as to almost certainly preclude their preservation)—it would be surprising if we *did* find abundant evidence of such a race, or any evidence at all without time and patience and good fortune. We would know little of their distribution or numbers, save for the evidence of bits of stone implements and the like. In the case of cliff dwellers, mound builders, pueblo builders, cave dwellers and their kind, it would of course be another matter. But even here, we have by no means learned all there is to know of the antiquity of such people in America. Here again, students of other lines of study beside anthropology will have to be called in to interpret properly and to understand much evidence that is available. Otherwise, grave error is the certain result.

Some months ago a discovery of unusual interest was made in southwestern Texas which upon investigation proved to be of exceptional importance. It was a discovery which gives us definite and positive evidence of the presence of man in America in Pleistocene, or glacial, times—evidence so definite and certain that no person familiar with such geology could question it. A general examination of the region showed that in late Tertiary times (before the Pleistocene or "glacial") the whole area in question was being eroded. It was a rather low, rolling region, cut by numerous relatively shallow valleys. Then, due to one of the vicissitudes to which the region has been subjected, the pitch or gradient of the whole area was for a time altered. It became more level, so that, when the Pleistocene deposits were being washed from the nearby higher Cretaceous and older rocks (the source of these sediments was determined) they were redeposited in these valleys which were cut down into Cretaceous and Triassic Age ("Age of Reptiles") rocks. Thus, the Tertiary valleys were refilled with Pleistocene muds, sands, and gravels, and in so doing, the remains of some of the animals of the time were naturally entombed. Later, the general level of the region again tilted and the old valleys were recut and restored to approximately their old levels. In the process, however, remnants of the Pleistocene beds were left along the sides of the ancient valleys.

The Realization of a Boyhood Dream

There is a kind of romance in the unusual career of the author of the accompanying article. Early in the 70's his father, a former army scout, homesteaded a ranch along the Niobrora River in Wyoming, near the Nebraska line. On that ranch there was a quarry, now called "Agate Fossil Quarry." It contained an abundance of Tertiary Period fossils. These fired the mind of the rancher's son. In time, after much study, he qualified as a trained paleontologist. Not only has he contributed specimens to many large museums, but his recent discovery of the fossil tooth of an anthropoid ape of great antiquity made him well known among scientists. In his honor others gave his find the euphonious name of *Hesperopithecus haroldcookii*—Harold Cook's western ape. ***– The Editor.***

At the particular spot in question, near the little town of Colorado, Texas, the complete articulated skeleton of an extinct type of bison was found buried under some eighteen feet of these old gravels, undisturbed and solidly cemented. The present little stream, Lone Wolf Creek, had slowly cut its way down to the old valley floor here, and under the vertical wall of Pleistocene sands and gravels, collectors from the Colorado Museum of Natural History, Denver, found a few bones weathering out just above the old valley floor. Following these by slowly and laboriously working back under the bank they came upon the whole skeleton. Bones of several other individuals of the same species were found to occur here and were collected simultaneously. But the important find came in taking out the complete skeleton. Lying close against and immediately along the under side of the neck was found a beautifully worked flint spear point! A second one, of similar and equally fine workmanship was found along and under the thigh bone. A third was found in the body cavity, but this point disappeared in the field, just after being found.

Ancient Bison, Ancient Flints: Ancient Man

Now—finding stone arrows or spear points associated with a "buffalo" skeleton may not seem at first glance an especially important bit of evidence. But let us consider a few facts in this case. First, the "buffalo" is not like the living American bison. It is larger, has flattened horns quite unlike the living American family, and is much more like the Indian or Asiatic buffalo. Undoubtedly, it is an Asiatic migrant into America. As yet undescribed and unnamed, it is waiting completion of comparative studies.

Continuing the search in these beds, the bones of more of these "buffalo" were found and, also, the bones and teeth of several other extinct animals, including a very large camel, two species of mammoth, a large and a small species of primitive horse, and a primitive deer. All of these species are of types closely comparable to species previously found in other parts of America in beds of known glacial times, or Pleistocene Age. True, no one yet knows just how late some of these species may have survived in America. But on the other hand, they are typical Pleistocene species, and it is certain that the evidence as to time is far more convincing and more probably certain when we consider the anatomical evidence in *several* families, all known to have been evolving rapidly, than that of merely *one:* that is, man—as considered by the anthropologists who take

TWO VIEWS OF LONE WOLF CREEK, NEAR COLORADO, TEXAS, WHERE THE FOSSIL BUFFALO AND HUMAN IMPLEMENTS WERE DISCOVERED

The fossils were found in the rock of the bank just above the water level, at the locality shown in the right-hand picture. A geological cross-sectional drawing showing the nature of the same strata and the valley filling, part of which has been eroded away, is shown on the next page

that attitude. Beyond this, all conditions carefully observed and noted in the field pointed clearly to antiquity, and eliminated all doubts as to the Pleistocene age of these deposits.

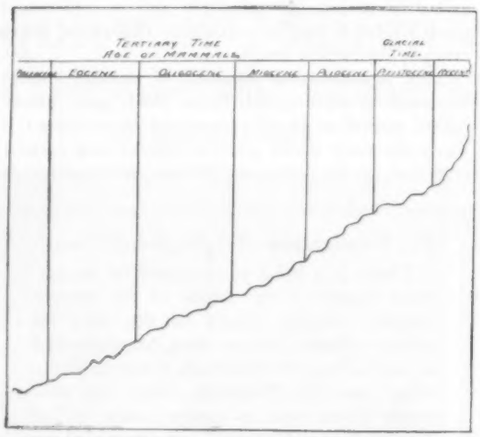
Now—consider the conditions, position and association as found. The bones are typically fossilized but are so extremely fragile that they disintegrate almost completely upon exposure, unless uncovered very carefully and hardened at once by special toughening solutions, such as shellac. It is utterly out of the question, as anyone familiar with such a deposit will know, that recutting at any relatively recent date, such as the time when Lone Wolf Creek cut down into these beds, could by any possibility have reached or disturbed that articulated skeleton under which the stone points were found, without disarticulating and destroying the skeleton. The matrix is a dense, toughly cemented, sandy gravel, whose original layers are clearly visible; and in such a matrix no amount of time, with percolating, mineral-bearing waters, could hide the evidence of artificial disturbance, such as man digging down.

"We Intend to *Know*"

In other words, there can be no possible doubt that those lance points (or extra large arrow points) are as old as, and contemporaneous with, that buffalo.

No matter what we call the time in which he lived, it was certainly a great many thousand years ago. In this connection, it is interesting to note that the writer found two cultural levels or stages above this in that area, the lower and older of which, while comparatively more recent, is also prehistoric. These people lived largely on a big species of fresh water mussel, now long extinct in that part of Texas. One of the principal village sites was found on a small arroyo, or ravine, which at that time was evidently a running stream. It is now about eighteen miles from living water. The evidences of erosion which are present also indicate considerable antiquity. These people lived here when southwestern Texas had a much wetter climate than it has today.

Let us drop back and take a glance at some interesting geological evidence. In the middle Miocene times, we begin to find evidence in America in rocks of that age (middle epoch of the "Age of Mammals") of the migration of Asiatic mammals into America, including the elephant. At the close of this period, we find marked evidence of continental elevation and a very mild climate extending far to the north, so that the ensuing Lower Pliocene Age in America is one of exceptional richness and interest. With the opening of the Pliocene, we find evidence of the



SEQUENCE OF THE LATER GEOLOGICAL EPOCHS

During these epochs the mammals, such as horses, rodents, bats, whales, man and so on, evolved into their present forms

migration of many kinds of land animals into America and, undoubtedly, many American stocks reached Asia at this time. With a warm climate extending to Alaska, as evidence shows, and a connection there with Asia, due to temporary elevation of what are now sea-bottom areas in the Bering Straits, we have every ideal condition for the entrance into America of many kinds of animals, including anthropoids or early man.

That such stocks did enter America at this time we know through the finding of the much-discussed *Hesperopithecus* from the Lower Pliocene beds near Agate, Nebraska, which antedates the classical *Pithecanthropus* found by Dr. Eugene Dubois in the Pliocene of Java in 1891-1892. It may here be stated that further evidence of such Pliocene stocks is now known to its discoverers and is under study. As yet we have found but the merest beginning of a start of the available evidence of Pliocene life in America. This is because only a small handful of men have really worked on its problems. The area and deposits to be examined will take centuries of time and many trained men. So little monetary backing has been given by Americans for such scientific research that the results are consequently restricted. A very few eager-minded Americans of means have been responsible for most of the work done, aided by a handful of men who were willing to sacrifice personal gain to seek out the fascinating secrets of such buried ancient life. Even our great National Museum, the widely known Smithsonian Institution, has such inadequate and niggardly financial backing from our Congress which maintains it, that its work is under a shameful handicap.

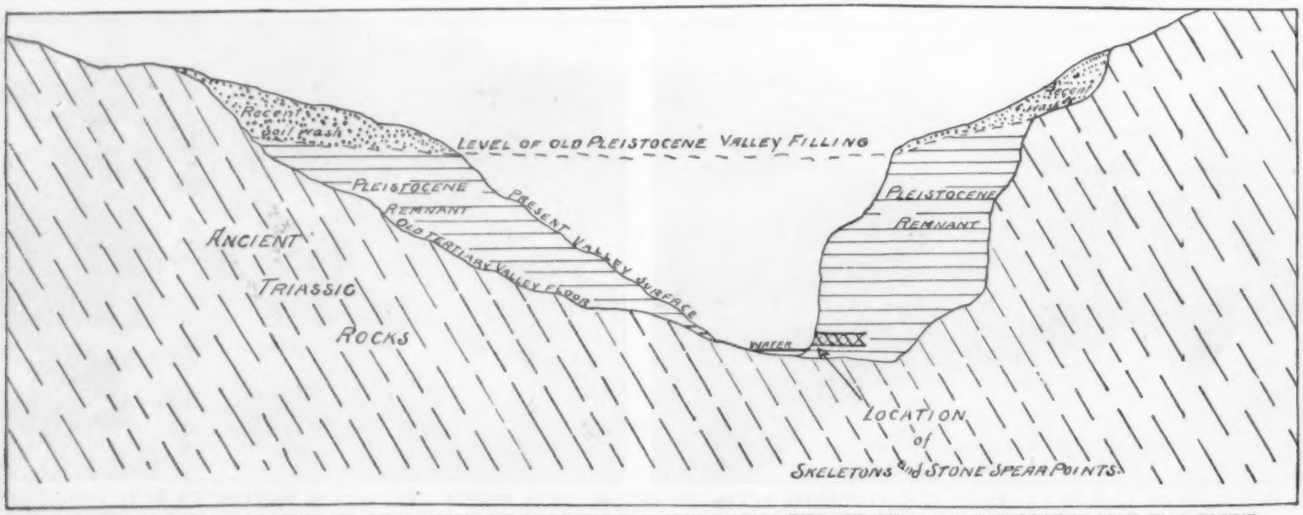
Through the persistent work of a few men in the last few years, however, a great deal of pertinent and striking evidence has been acquired, but scientists will be slow in announcing results until this is amplified with further discoveries and studied with the utmost care and scrutiny from all possible angles, where the possibility of human or humanoid remains are concerned. This is necessary and proper where hundreds of thousands of years, or longer, are involved. We do not want to fool ourselves. We intend to *know*.

"Cold Facts Are More Convincing"

Determination of the age of deposits before glacial times and, to a large degree, the problems of accurate determination of the age of glacial deposits, falls primarily within the province and special training of the geologist and chemist, and not the anthropologist. In the past few years, several reports have been made of the finding of man or his implements in deposits of probable Pleistocene age. Some of these discoveries may not be old, others almost certainly are; and the finding of the Pleistocene artifacts above mentioned in unquestioned Pleistocene in Texas should go a long way toward removing categorical denials of the possibility of glacial man in America. Logic and inference are invaluable but cold facts are more convincing.

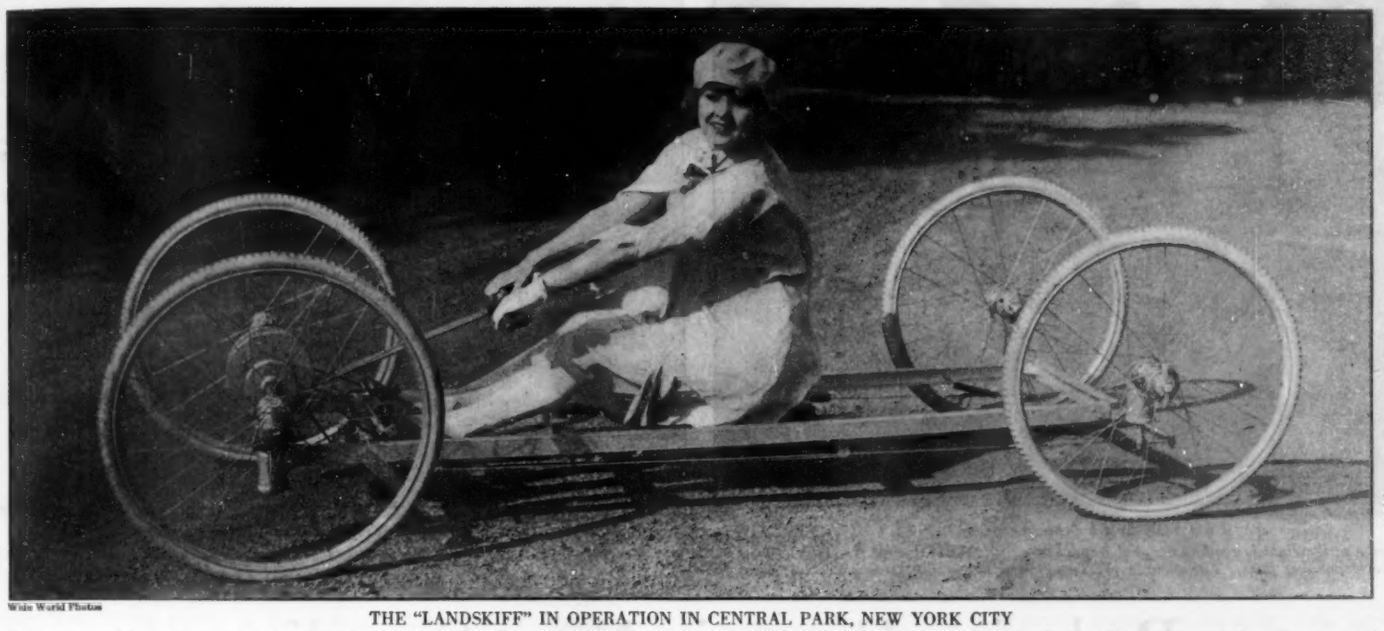
We are finding in North America, China, and Mongolia at this time numerous geological and paleontological evidences of interrelationships, and some of these relationships certainly go back into millions of years. While early man is even yet little known, he is certain to be known better and "traces along the road" will be found that are indisputable.

It is well to keep another point in mind. Modern methods are now as never before making possible the working out of sub-sea geography in the great oceans. With this comes a better appreciation and understanding of the instability of the earth's crust and the lack of permanence of land areas. There is a strong suggestive evidence of other ancient land connections from the south, besides that of the Bering Straits—connections that may prove to have had a far stronger hand in shaping the life-destinies in America of both man and beast, than we are as yet prepared to admit. With these and many other considerations in mind, we await tomorrow's discoveries, knowing they will come and feeling certain they will show our human history of America back into, through and beyond, glacial times.



DIAGRAMMATIC CROSS-SECTION OF THE VALLEY OF LONE WOLF CREEK, WHERE THE EVIDENCE OF PLEISTOCENE MAN WAS FOUND

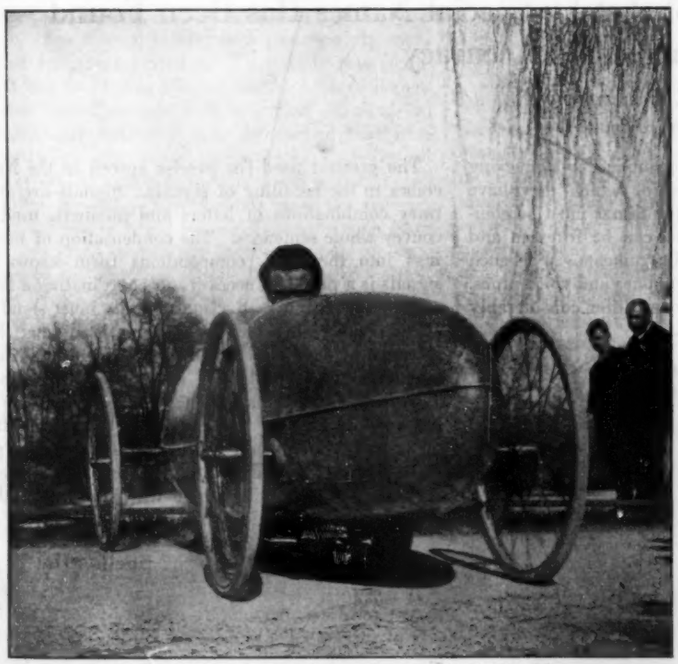
The relations of the several geologic formations are clearly shown, while the details of the situation under which the evidence was found is explained in the text



Wide World Photos

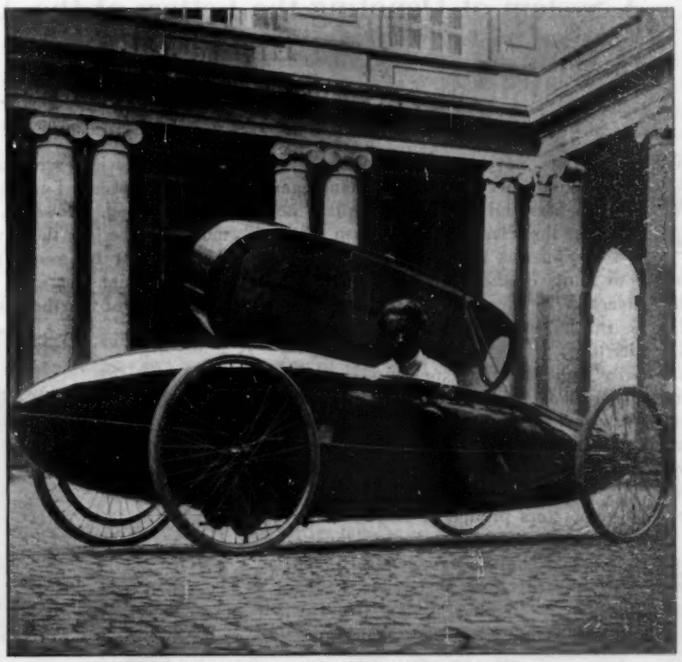
THE "LANDSKIFF" IN OPERATION IN CENTRAL PARK, NEW YORK CITY

This open model of the ingenious hand-propelled vehicle devised by a German physician serves to show the component parts of the device. Notice in particular the strap and handle by means of which the vehicle is propelled, the sliding seat and the underslung position of the chassis in relation to the centers of the wheels



THIS MIGHT BE CALLED A "ROADSTER" MODEL

A front view of one of the "landskiffs" without a top enclosure. The low center of gravity and the four-inch road clearance are particularly noticeable in this photograph as is also the low position of the driver



LIMOUSINE MODEL WITH THE TOP UP

This is one form of the vehicle that is very popular in Germany. When the top is lowered over the occupant, complete protection from road dust is afforded. The driver enters by stepping in with the top up as shown

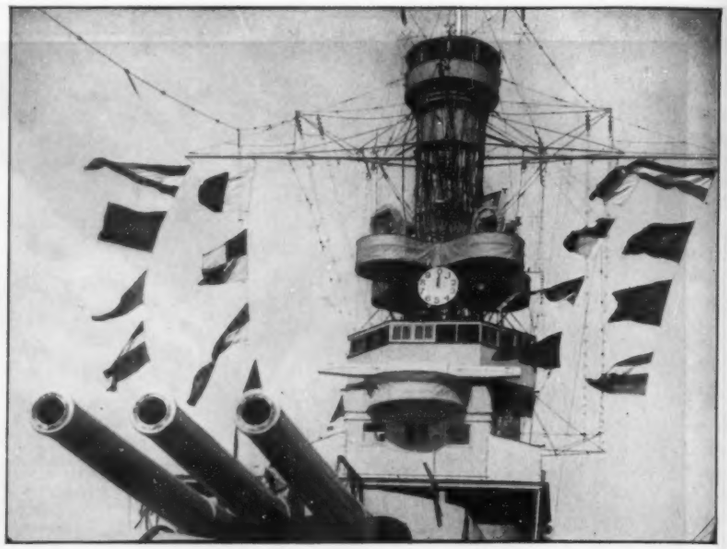
A Practical Hand-propelled Vehicle of Unique Construction

A German physician of Yankee descent, Dr. Manfred Curry, has invented a novel form of vehicle which, it is said, has taken Germany by storm. The photographs reproduced above give a very good idea of the machine. In essence, the mechanical features consist of a gearing and ratchet arrangement that converts successive pulls on a leather strap to a rotary motion at right angles to the pull, brakes on the front wheels and a steering arrangement for the rear wheels. Entering the vehicle, the rider sits in a seat that slides on a pair of rails in much the same manner as the seat in a rowing shell. His feet rest on strongly braced projections and a handle fastened to the strap is in easy reach. Propulsion is obtained by pulling on this handle and exerting the force in much the same manner as oars are manipulated in rowing. It is said that the device is easier to propel than a bicycle and that the exercise afforded by it is very beneficial. Speeds of 35 miles per hour are said to be obtained with little effort on the part of the driver. The inventor is now in America, surveying the field here for his device. Factories in Germany have turned out in excess of 46,000 of the vehicles at the time of writing and they have become very popular, probably because of the high cost of gasoline and automobiles in that country. Whether the device will find favor in the United States is problematical, due to the low cost of private motor transportation here.

All illustrations U. S. Navy Official Photographs

TWO FORMS OF NAVAL SIGNALING

The man at the right is reading a signal from the flag ship. The two at the left are hoisting corresponding flags. The man in the background is sending "semaphore" signals



FLAG HOISTS ON THE U.S.S. "PENNSYLVANIA"

The four strings of flags flying from the foreyard are all separate signals and each one has a meaning of its own. These strings are used for inter-ship communication

Reducing Errors in Navy Signaling

A System of Denoting the Letters of the Alphabet by Special Names Has Been Found Highly Effective in Increasing Accuracy

By Alfred P. H. Tawresey
Lieutenant-Commander, United States Navy

WHO has not experienced difficulty in making other persons understand names, numbers and other commonplace items over the telephone, even when the connection was faultless? Are such incidents due to faults of the speaker or shortcomings of the listener? Neither one, for the root of the trouble is, in the final analysis, a defect of the language itself.

Familiarity with the subject under discussion and a running knowledge of the context doubtless aids in mutual comprehension. However, even with such knowledge at command, ordinary speech, rendered perfectly, is inadequate where extreme precision is required.

Telephone operators pronounce and accent words and numbers in a manner peculiar to themselves, and use stereotyped phrases, monotonously familiar, but distinctive and precise. This is the result of a deliberate system of training, designed to promote uniformity and thereby to minimize chance of error.

Naval Telephones Are Different

All sailors come from the land. They learn in infancy that one side of the body is "right" and the other is "left." It is essential in maneuvering a ship, however, that when one speaks of a given side of the vessel, the meaning be absolute and not relative to the direction in which speaker or listener happens to be facing. Hence the terms "port" and "starboard" were adopted in the dim and distant past, to mean definite sides of the ship, entirely independent of her direction of travel, position, or the position of the people in her.

When a warship goes into battle, or even when she exercises in preparation therefor, officers and men are at their several stations. They are separated by myriads of decks, bulkheads and doors. In order that activities at the several stations may be coordinated, they must be able to communicate orders and information. In many cases mechanical and electrical devices serve well enough for conveying the pre-determined meanings for which they have been designed. However, many things must be communicated besides those which can be foreseen and provided for by means of instruments. For such communications there are telephones and voice pipes.

In a man-of-war the telephones differ considerably

ON WATCH WITH A TELEPHONE

Silhouette of a sailor wearing a navy telephone with a breast-plate transmitter and a pair of earphones

from those in common use on shore, insofar as their mechanical construction and the manner of their use are concerned. Instead of a person at each end of a line, the lines usually connect several persons at different stations. Head-phones and breast-plate mouthpieces are in universal use. It is obvious that these telephones must be ruggedly built, and a night watch in a tropical sea loses some of its romance when it involves wearing one of the sets for four hours at a stretch.

The greatest need for precise speech in the Navy comes in the handling of signals. Signals are arbitrary combinations of letters and numbers, used to convey whole sentences. The condensation of meanings into the brief, compendious form known as signals is a practical necessity in coordinating a fleet.

Signalmen who read visual signals must stand in exposed places in order to see them, and what they see must be communicated to the commanding officer as rapidly as possible and with absolute accuracy. They may communicate by telephone, voice pipe or by word of mouth. In any event there are often many things to contend with, such as hampering gas masks, wind and weather, whistles, gunfire and machinery noises, as well as bells, buzzers and other necessary but noisy devices in a man-of-war.

"Hypo-affirmative-tare" Spells "Hat"

It was early discovered in the Navy, as elsewhere, that the ordinary sounds by which we know the letters of the alphabet and the numbers do not provide the necessary accuracy, even under favorable conditions. This is for the very elementary reason, inherent in the language, that differentiation between many letters with a similar sound depends upon the consonants in the sound. Except when within easy hearing of a person speaking, and when reasonably free from any interfering noise, many of the consonants, such as "t" or "h," cannot be heard. There are others, such as "s" and "z," which have, so to speak, more carrying power. Still other consonants depend for carrying power almost entirely on their associated vowel sounds, such as, for example, "b," "d," "m" and "n."

The natural solution to the problem of accurate communication was to name each letter and always to speak of the letter by its name. When the system was first tried, each person was permitted to use names of his own selection for the letters. This process was similar to that sometimes used in private life, where one will spell a word in the following

"UP ANCHOR"—USING SIGNALS

Even in this part of naval maneuvering, the signal men with their telephones are indispensable

manner: "hat, 'h' for Henry, 'a' for apples, 't' for tiger."

This method did not prove entirely adequate. There was a lack of uniformity which did not aid accuracy. Individuals chose names of varying length. Some were briefer and consequently more efficient for naval purposes. To remedy this condition it was decided to adopt a standard list of names.

From the experience with this first standard list of names for letters, it was determined that it is necessary in some cases to have words of two or more syllables, with a distinctive vowel sound in each syllable. Accuracy then depends upon the recognition of successive vowel sounds, following each other in a prescribed order; the specific sounds for each name and the order of sounds being sharply differentiated from that for any other name in the list.

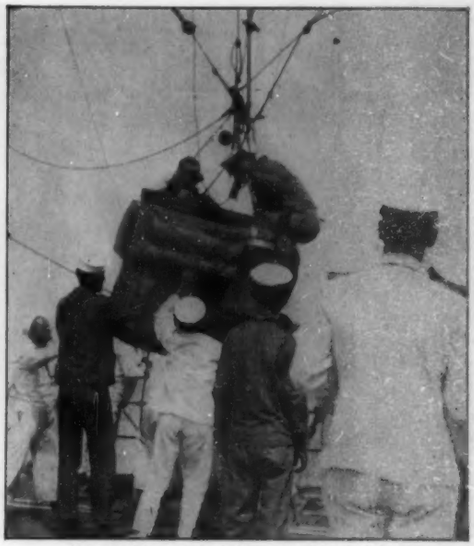
It is interesting to observe the difference between these principles and those upon which shorthand is based. In shorthand the vowels are omitted as being understood and are supplied by the stenographer when transcribing the completed work. In the Navy's method of communicating the letters of the alphabet, the consonants often are not heard. The listener mentally supplies the consonants which he has been trained to know belong in those particular words, as designated by the vowel sounds.

In revising the list of names of letters for the Navy, some letters which had not given any special trouble were changed to make the names coincide with certain secondary meanings used in some naval work. Furthermore, an abbreviation of the name is permitted, where it is necessary to write the name instead of writing only the letter. The list of names for the letters of the alphabet, as revised, is as follows:

A—AFFIRMATIVE (written Afirm)
B—BAKER
C—CAST
D—DOG
E—EASY
F—FOX
G—GEORGE
H—HYPO
I—INTERROGATORY (written Inter)
J—JIG
K—KING
L—LOVE
M—MIKE
N—NEGATIVE (written Negat)
O—OPTIONAL (written Option)
P—PREPARATORY (written Prep)
Q—QUACK
R—ROGER
S—SAIL
T—TARE
U—UNIT
V—VICE
W—WILLIAM
X—XRAY
Y—YOKE
Z—ZED

Difficulty in comprehending spoken numbers has not been so great as was the case with letters. All numbers are considered as being made up of the digits composing them, so that the ten sounds, "one" to "nine," inclusive, and "zero," serve to convey any numerical value. The principal difficulty which has been encountered has been the similarity of sound, under adverse hearing conditions, between "nine" and "five." This has been obviated by pronouncing "nine" in the normal way and by pronouncing "five" as though it were spelled "fife." In some special cases numbers are passed in other than the single digit form, and in these cases some difficulty has been encountered in distinguishing between "fifteen" and "fifty." In this case "fifteen" is pronounced normally, but "fifty" is rendered "fife-ty."

In the Navy there often is occasion to send telegrams in which appear single letters, or combinations thereof. In the case of trademarks, drawing numbers, arbitrary designations and similar items,



UP IN THE AIR WITH A TELEPHONE

The cable of telephone wires is fixed to the line that holds the observation balloon to the ship

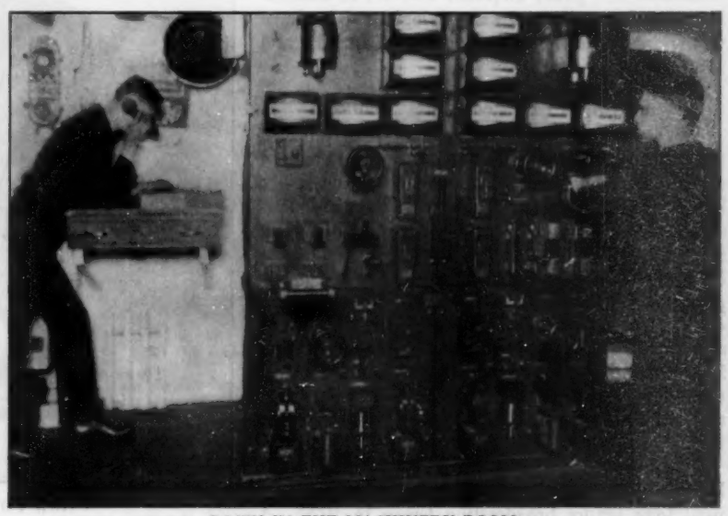
it is frequently essential to the value of the message that the addressee receive single letters and numerals correctly.

In private life there exist a few isolated instances of attempts to secure accuracy in the case of frequently mistaken items. For example, "Eye" is sometimes written for "I," and "You" is written for "U." If, as in the Navy, there exists between writer and reader, or between sender and addressee, a standard practice of rendering all numerals in words and of using specified names for all single letters of the alphabet, or for the individual letters of occasional detached groups, the chances of error due to the telegraphic agency will be minimized. Mistakes in spelling are ordinarily not enough to prevent the addressee from understanding the meaning intended.

Spelling over the telephone would be speeded up and would be improved in accuracy, if instead of using an optional and individual set of names, which have to be explained, and which may be ambiguous, a standard, unmistakable set could be employed. Reverting to the example of spelling the word "hat" over the telephone, it is obvious that accuracy would be promoted, and that time would be saved if the public understood a common system and if "hat" were designated in such cases by saying "hat, hypo-affirmative-tare."

TELEPHONES AND GAS MASKS

With gas masks adjusted and under fire, communication is necessary at all times. The hatless sailor behind the gun is wearing a telephone for sending and receiving orders



DOWN IN THE MACHINERY ROOM

The man at the left is receiving orders by telephone. He has to contend with machinery noises as well as two loud-speaking telephones located near his head, one of which shows

Herbert Photos

AN ALTERNATING-CURRENT RECEIVER

Francis R. Hoyt, third from left, who developed this set that operates from the house-lighting socket. At the right is Lambdin Kay, announcer at WSB, Atlanta, Georgia

Herbert Photos

ONE OF THE 1926-27 RADIO STYLES

A new eight-tube set built on the neutrodyne principle and tuned by a single control that makes ten adjustments. Note the metallic shields and frame of this receiver

Autumn Styles in Radio

Alternating-current Operated Receivers Are An Outstanding Development

By Orrin E. Dunlap, Jr.

AUTUMN brings new styles in radio equipment and a survey of the etherial "fashions" reveals that the sets operating in connection with the house-lighting mains, thereby dispensing with batteries, will lead as the outstanding development this season. The importance of this type of apparatus is seen in the light it casts on the main trend of radio progress. It is expected that the batteryless circuit will gain rapidly in popularity, just as soon as the public is convinced that such receivers are practical, and that five years hence this type of set will be most generally used. As a new factor it will undoubtedly stimulate radio replacements and the sale of receivers to a wide extent.

Those who have been waiting for the batteryless sets will find a variety on the market this season, and those who now have battery-operated receivers in their homes will find that the new combination "B" eliminator and power amplifier will aid in modernizing the old equipment by supplying the "B" voltage to the tubes, and by improving tone quality and volume.

The Hum Presented Chief Problem

Ever since broadcast receivers took their place in the American home, radio engineers have realized that the batteryless set was in demand. But it has been a problem to adapt radio receivers to use alternating current without producing a hum. The puzzle has been tackled from two angles. Some engineers have tried, from the beginning of their endeavors, to produce an alternating-current tube. Others, taking cognizance of the fact that there are millions of receivers in use equipped with battery-operated tubes, have directed their attention to current-supply devices designed to rectify the alternating current of the house-lighting system to direct current of the proper voltage to operate battery-type tubes.

Rectifiers and filters, which form the basis of most battery substitutes, are not new devices. They were used long before broadcasting began in 1920. A German patent granted to Koch and Sterzel on December 5, 1906, showed rectifiers and filters in combination. As one engineer has pointed out, the condensers in the circuit serve as storage tanks which receive the impulses of the rectified current and deliver current of a smoother nature. The choke coils act as a turbine having a flywheel, whose duty it is to keep the power flowing smoothly in one direction. It is important that there is ample choke-coil inductance and condenser capacity.

Many "B" battery eliminators have been introduced to radio set owners during the past two years and they all operate on the same general principle. They consist essentially of a transformer, a rectifier and a smoothing filter. The main differences in the various devices are in the type of rectifier and the details of the filter; the important feature of the latter is that it must pass uniform undulating current with a minimum of irregularities.

Courtesy Pacent Radio Corporation

A NEW POWER UNIT

The "Powerformer" in the small case at the right connects to the house mains and supplies the plate voltage for all tubes. It also serves as a power amplifier

There are now two general groups of rectifiers, the vacuum tube and the electrolytic types. The tube rectifiers are either of the thermionic valve type or of the cold-cathode, gas-filled bulb. It is these rectifiers which are rapidly gaining in popularity, because they are compact and there is no liquid to handle or spill.

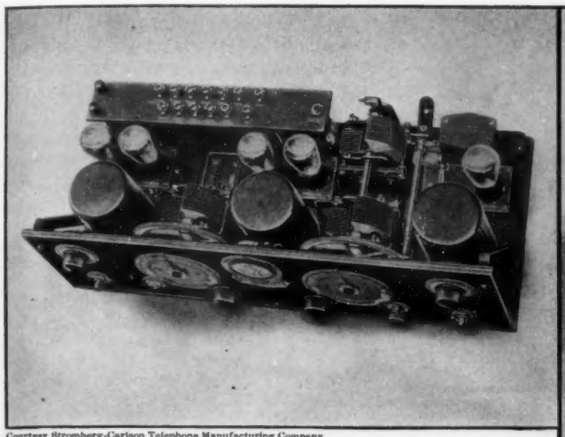
Engineers explain that the main disadvantage of the tube rectifier is that their high internal resistance necessitates the use of a high-voltage transformer, and therefore, about 80 percent of the current consumption goes to generate heat in the rectifier tube.

Two types of electrolytic rectifiers are used in "B" power units. One uses tantalum as the rectifying electrode and the other employs aluminum. The electrolyte is sulphuric acid in the tantalum rectifier. A solution containing several salts is used in the aluminum rectifier.

A Tube Without a Filament

Some receivers, generally those using radio-frequency circuits with one or more reflexed stages and operating in conjunction with loop antennas, are often difficult to operate with a "B" eliminator without a hum even when the best filter system is used. Receivers which are very sensitive to magnetic induction caused by the transformer of the power unit are likely to show signs of a hum. In such cases the power unit must be placed further from the set or heavy shielding must be employed.

Despite the progress being made in developing battery substitutes, there will always be a demand for battery-operated receivers because millions of homes are not equipped with electricity. However, there is every indication that the house-current operated sets will win favor among radio set owners this season and within five years the power set will be more in demand than the battery-operated circuit. It is probable that the sets using alternating current will employ fewer tubes than the present sets, because it is expected that alternating-current tubes will be capable of handling more current and therefore give increased volume without distortion. Ten years from now there probably will be few receivers equipped



Courtesy Stromberg-Carlson Telephone Manufacturing Company

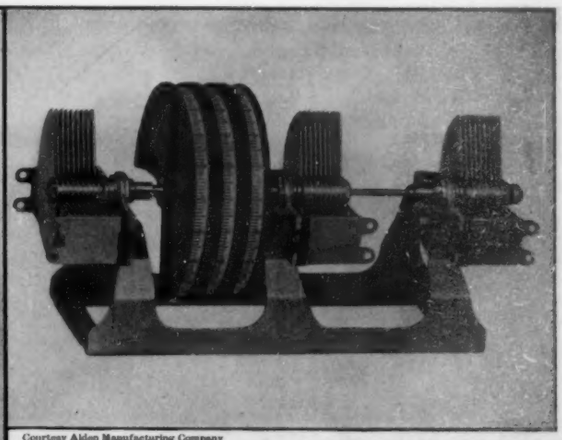
ONE OF THE NEUTRODYNES

Note how the three tuning coils, or neutroformers, are housed in heavy copper cans and how two tuning condensers are mounted on a single shaft and controlled by one dial

Courtesy McCullough Sales Company

ALTERNATING CURRENT TUBE

This tube fits a standard socket but the alternating-current filament terminals are on the top



Courtesy Alden Manufacturing Company

LOCALIZED CONTROL UNIT

This is one of the new tuning condenser units which dispenses with dials. The controllers extend through the panel of the set and may be easily revolved by the fingers

with more than five tubes, including the power amplifier, which will have no tendency to overload.

For a long time the main obstacle to the majority of manufacturers of "B" eliminators was the rectifier tube. Now there are several rectifier tubes on the market: the UX-213, a full-wave rectifier giving an output of 65 milliamperes; the UX-216-B, a half-wave rectifier with 65 milliamperes output, and the Raytheon tube, which is said to be built upon an entirely different principle, the forerunner of which was the "S" tube. The underlying principle is that any gaseous tube which has one very small electrode and one large electrode is a partial rectifier; that is, the current flows more readily when the larger electrode is made negative than when it is positive.

This tube has no filament to burn out and requires no rheostat. Helium gas is used inside the bulb. A quart of helium at atmospheric pressure is said to be sufficient for 700 tubes. The tube depends upon ionization for its action, and therefore the vacuum is not nearly as perfect as in the standard radio tubes. The type BH Raytheon tube will pass 85 milliamperes.

For years scientists searched for insulators that would stand up under intense heat and would not break down under extremely high-voltage stress or deteriorate with age. Mica, lava, glass and porcelain, all were tried without avail.

After years of development work on gaseous rectifiers, C. G. Smith of Cambridge, Massachusetts, discovered that the desired insulator was the very gas with which he was working. It was found that this and other gases would not conduct current between two electrodes that were close together. The Raytheon rectifier was built with this "short path" insulator as the foundation.

One of the problems was to produce an electrode surface that would give the most satisfactory performance. Dr. Vannevar Bush, Professor of Electrical Engineering at the Massachusetts Institute of Technology, was the leader in this work. Under his direction a special heat treatment was developed that not only assures long life for the tube, but also lowers the voltage drop. This makes possible excellent regulation, or, in other words, the ability of the device to hold its output voltage at varying conditions of load or current drawn.

Glass as a Rectifier

There is one alternating-current tube which eliminates the necessity of "A" and "B" batteries. This tube has the combined features of a rectifier, detector, oscillator and radio-frequency amplifier. As a power amplifier the tube is rated with an amplification factor of eight. The bulb has a metallic base, which is used as the fifth connection. The base is connected to the cathode which controls the electron emission. A plate voltage up to 200 volts may be applied to the tube without danger of overheating. The cost of operating this tube is estimated to be one cent per hour for a five-tube set. The life of the tube is about the same as the present battery-operated tubes.

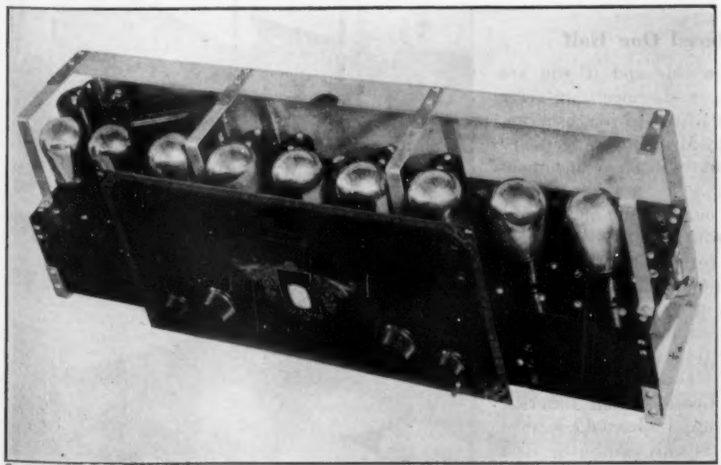
It is estimated by engineers that the house-current operated sets on the average will consume energy at the rate of approximately eight kilowatts a month.

A new instrument known as the "Transifier" was introduced to radio fans this fall. It furnishes either two, four or six-volt filament-current supply for operating multi-tube sets consuming not more than 2¼ amperes. A built-in automatic switch controls both "A" and "B" power units when the receiver is in use. The cost of operation is estimated to be approximately one-half cent per hour.

There is also a "B" Transifier which operates directly from the light socket, eliminating both "B" and "C" batteries. It supplies current up to 60 milliamperes at 45, 67½, 90 and 150 volts and also 4 and 12-volt "C" battery current. This device will operate with sets equipped with ten tubes or less. A single control adapts the output to the proper current requirements.

The "B" Transifier is also built in a smaller model designed to supply the plate voltage for sets using six tubes or less. The maximum output is 100 volts and it is estimated that the cost of operation is less than one-tenth of a cent per hour.

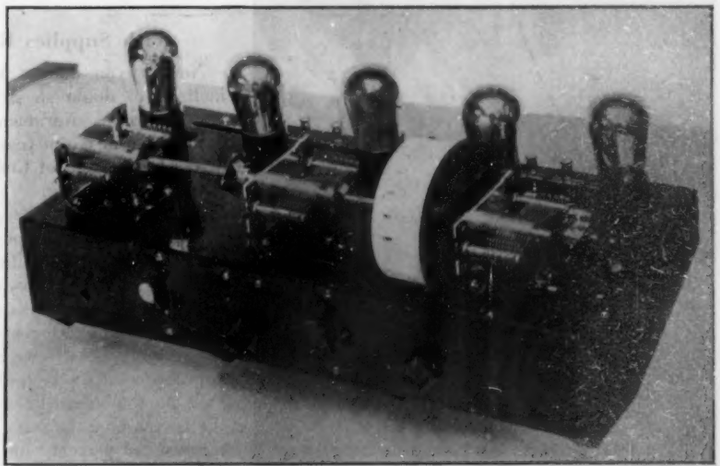
"Silite" electrodes are another new feature this season. They are metallic-glass rectifying elements, based upon the rectifying property of silicon, or sand. They are said to give a higher charging rate than most electrodes. Silite makes possible the conversion of "A" batteries into "A" power units.



Courtesy Frieze Radio Corporation

THE RADIO-SET CHASSIS

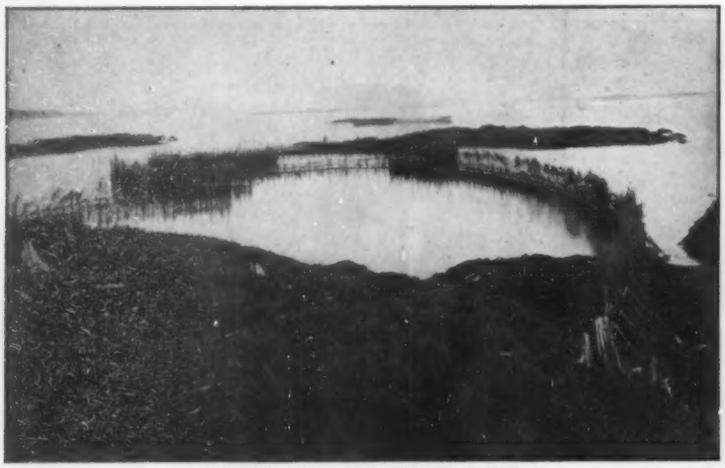
Many manufacturers are building their 1926-27 models on metal chassis to give strength so that the instruments will stand shipping and will not be too delicate for the handling that they will get in use. The model shown is known as the "Straight 9"



Courtesy Crosley Radio Corporation

INNOVATIONS IN CONSTRUCTION

The metal chassis of this one of the 1926-27 models is designed to act as a shield to prevent interference from outside electrical influences. Note how the condensers are built on one shaft and tuned by the drum control on which the wavelengths may be recorded



HERRING WEIR, EASTPORT, MAINE

Fish enter this brushwood weir at the left and swimming to and fro against the opposite side of the weir, fail to find their way out

STONY POINT, POTOMAC RIVER

A shad-fishery seine on the Potomac, just before being landed. The seine, paid out in a half circle, is drawn in to the beach

Uncle Sam, Spendthrift—VI

The Destruction of Many of Our Finest Fisheries Has Been Only Less Complete Than the Destruction of Our Forests

By J. Bernard Walker

IT is a strange anomaly that in this age of free inter-communication and of wide and rapid diffusion of knowledge, so many people should live in complete ignorance of certain serious economic conditions, which threaten the continued welfare and happiness of these United States. We have in mind the facts which have been revealed in the present series of articles on conservation. In this survey we have endeavored, without any exaggeration or sensationalism, to show that in drawing upon the rich, natural resources of the country our forbears, and for that matter we ourselves, have apparently taken absolutely no thought for the future; with the result that we have swept away four-fifths of our marvelous forests and have skimmed the cream of our great supplies of oil and coal, leaving of the last named only the inferior fields for the use of a future population which is growing by leaps and bounds and making an ever increasing demand for these necessities.

It is certain that nine out of ten men, we had almost said 99 out of a 100, have never given any thought to the seriousness of the rapid depletion of our forests, although it is going on daily under our very eyes; and, so long as they could get all the oil they wanted at the filling station, the vast majority of the people of the United States have thought little and cared less how the oil was secured and whether the supply was in danger of exhaustion.

In the present chapter on the depletion of our fisheries we deal with another question of vital importance to the future well-being of our country. At the outset, we ask the reader of these lines if he is aware that Uncle Sam has been such a spendthrift in using up the magnificent supplies of fish with which God had stocked our rivers, lakes and coastal water, that some of our most prolific fishing grounds have been depleted to exhaustion, and some of our most delicious and most-sought-after species of fish have been practically swept out of existence.

ABOARD AN ALASKAN FISHERMAN

A good catch of codfish, as the result of only 20 minutes fishing with hand lines

Fish Supplies Reduced One Half

Now if you do not know this and if you are inclined to doubt so strong a statement, we refer you to certain government statistics of our fisheries, as set forth in recent years by Mr. Hoover, Secretary of the Department of Commerce, in many an urgent message of warning.

Learn then that, although our Atlantic and Pacific littoral waters once teemed with huge runs of salmon, shad, sturgeon and mullet, to say nothing of great stocks of lobsters, crabs, oysters and clams, the very ease with which the fish could be caught has led to their undoing. "Our great supplies of salmon on the Atlantic Coast," we are told, "have totally disappeared as a food supply." Granted, you say, but look at the great Pacific Coast salmon fisheries. Well, even here the salmon supplies have diminished by over 50 percent, and it is only within the last few years that the government has taken measures to stop the destruction. Even in Alaska, the remaining great salmon fishery of the world, reckless exploitation has threatened the extinction of the salmon within half a generation. Fortunately, two years ago the government put in force measures which promise to save this great fishery. The sturgeon fisheries have declined 98 percent in some 42 years on the Great Lakes and they are almost gone on our coast. The yield of the shad fisheries has decreased over 70 percent. Seventy-seven years ago 22,000,000 shad were taken in the Potomac River alone in a single year, whereas today we are told that 800 fishermen take with difficulty less than 600,000 fish per year from this river; and the Potomac, bear in mind, is the finest of the remaining rivers for shad.

The same story of depletion applies to the river herring, striped bass, and sea trout, which are decreasing rapidly, as are the supplies of crabs, lobsters, oysters and clams. As late as 1915 the Chesapeake and Delaware crab fisheries yielded over 50,-

IN OLD GLOUCESTER HARBOR

The cod, after being cleaned, are spread out on wooden racks and left to dry

000,000 pounds; but today the yield is less than one-half of that. The oyster fisheries of the Chesapeake have fallen 50 percent in the short period of 20 years; and our lobster catch is less than one-third of that of 30 years ago. Uncle Sam certainly has been spendthrift of his wealth in fisheries, and the above enumeration, mark you, refers only to littoral and inland fisheries. It is a fact that even some of our deep-sea fisheries, such as those of the halibut in the Northern Pacific, already have been over-fished.

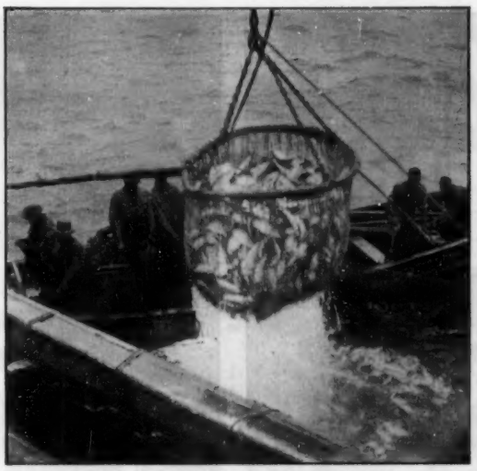
Let us now look at the question of fish supply from a new angle—that of sport and recreation. "Game fish," so called, although they do not bulk largely in the question of food supply, are of the first importance as affording one of the healthiest and most popular means of outdoor recreation, Secretary Hoover, in an address delivered in 1924 before the United States Fisheries Association, referring to the effect of the automobile and good roads in sending the people outdoors for recreation said: "I do not consider it an exaggeration to say that this summer will have seen two million anglers upon our streams and coast. In one state alone 200,000 individual (fishing) licenses have been issued this year." There is a consensus among devotees of the rod and line that game fish are decreasing rapidly under this pressure.

Protective Legislation Necessary

Not only do the fishermen reduce the number of fish that reach the spawning grounds, but there is another and most serious obstacle in the shape of the dams which are being built in increasing numbers across the rivers and streams of the country. The reservoirs thus formed, many of which reach for a score of miles or more back through the valleys, cover up, at times, favorable spawning ground for fish, and the dams themselves form an insuperable obstacle to the progress of the fish up the rivers. Around such dams as are not too lofty for the purpose fish ladders should be constructed.

The obvious method of control here would be for the states and the Federal Government to combine in some form of protective legislation similar to that which is doing such fine work in the protection of our migratory birds—a subject which we shall deal with in a subsequent chapter of this series.

An even more destructive enemy of our game fish is the pollution of our rivers and streams by sewage and by the wastes poured into them in ever increasing amounts from the towns and villages through which they flow. Already this cause alone is answerable for



THE GREAT MENHADEN FISHERY

This view shows the fish being bailed from net to be dumped into the hold of a schooner

the extinction of the fish in many streams that once were prolific fields for the fishermen, and the process of destruction goes merrily on. Such great strides have been taken in late years in the development of sewage purification plants that the various state legislatures would be justified in prohibiting the discharge of sewage into our rivers. The habit, judged from the esthetic side, is a filthy one in itself, a survivor from an earlier and cruder period of our history. Not only the sewage of the population but the liquid wastes from the various factories are pernicious. Stream pollution should be stopped by the strong arm of a law backed by a clearly expressed public opinion. When that has been done and a proper control of fishing licenses and technique is everywhere enforced, our streams will flow in their pristine purity and will teem once more with fish.

Just here a word of warning. We must not be deceived by the enormous gross value of our fisheries' products. The annual increase has been brought about by increased prices, increased number of fishermen, and by a very great increase in the *proportion* of deep-sea fish. Do not forget in looking at these great and growing figures, that they are accompanied by a great decrease in the quantity of littoral fish that has been caught and by a marked decrease in the catch per man.

It is probable that there are young people among us who will live to see the day when the population (and hence the food demand) of the United States has been doubled. In this matter of conservation we owe a duty not merely to our own, but to future generations. We have painted a deplorable picture of the spendthrift policy, or lack of policy, which has characterized our attitude toward fisheries during the past life of the nation. What of the future? Can the mischief be repaired? Will there ever come a day when our coasts and inland bays will be alive once more with those valuable species of fish which, as we have seen, are now all but extinct?

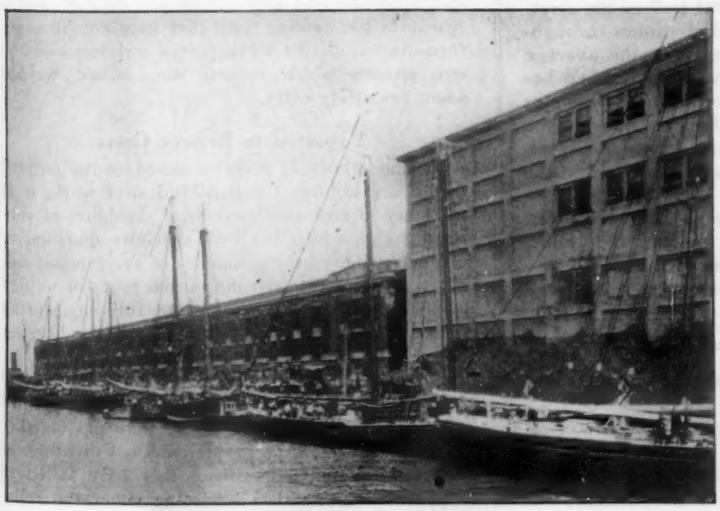
States Must Cooperate

The answer is emphatically "Yes," and the work can be accomplished by hearty cooperation among the states and between the states and the Federal Government. Hitherto, in this as in other matters affecting the general public welfare, the states have been divided by their age-long jealousies and suspicions. If we are to achieve results in solving this fish problem, the states must get together and do so quickly. Already a start has been made, and the following facts show that the work is progressing satisfactorily.

Firstly, Congress enacted last winter federal legislation controlling oil pollution of coastal waters. Secondly, by negotiation with Canada we have secured the Pacific Coast Halibut Treaty, under which the two nations can stop the depletion and start the recuperation of that great fishery. Thirdly, Congress, some two years ago, enacted the Alaskan Salmon Fisheries Conservation Bill, and as a result destruction has ceased and the rejuvenation of these fisheries is in active progress. Fourthly, there has been passed by Congress the Upper Mississippi Fish and Game Refuge Bill. This means that the streams of the Upper Mississippi will be preserved for the breeding of fish and game. Lastly, Congress has met with some success in bringing about cooperation between different states for the protection of fisheries.

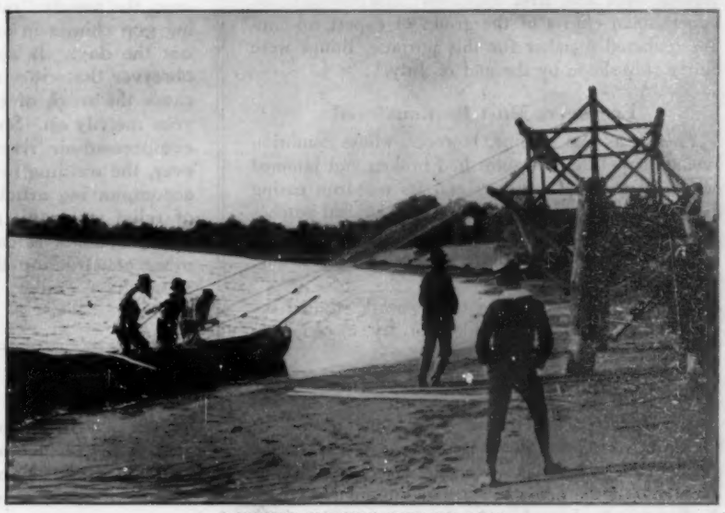
We have sketched the problem of our fisheries only in broad outline. Limitations of space prevent any detailed account of the Bureau of Fisheries, whose activities form the foundation of all constructive conservation. An adequate description of the fine work of this Bureau would call for a complete chapter in itself.

¶ *In a future issue will appear another article of this series which will deal with the depletion of game in the United States and the work which has been accomplished in game protection, notably as regards our migratory birds.*



THE BOSTON FISH PIERS

A fleet of schooners discharging fish from the Newfoundland Banks. Their topmasts have been removed and motors installed. Few schooners use sail only



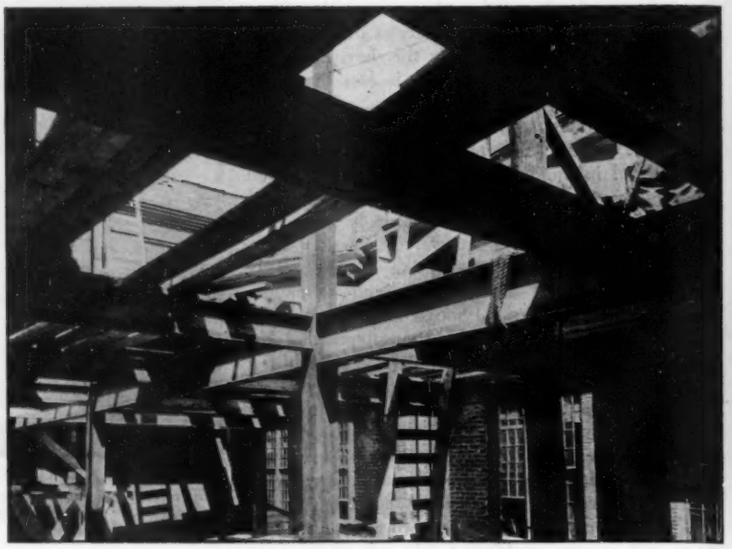
ROLLING UP GILL NET TO DRY

Nets are an expensive item in the fisherman's outfit. After use they are spread on the ground or rolled on circular racks to dry so that they will not rot

All photographs courtesy Westinghouse Electric & Manufacturing Company

A TEST OF WELDED AND RIVETED SPECIMENS

At the Carnegie Institute of Technology, several elaborate experiments have been carried on. This photograph shows a group watching one of the interesting tests



BEAMS WELDED TO COLUMN

This is a sample of work done at the Westinghouse plant, at East Pittsburgh, Pennsylvania. Note the smooth column and the absence of angles and brackets

Can Welding Replace the Rivet?

Tests That Have Been Made Under Identical Conditions Show That Steel Structures Fabricated With Welded Joints Have Inherent Advantages Over Those Which Are Riveted

By A. M. Candy

Welding Engineer, Westinghouse Electric & Manufacturing Company

WHEN American officials took over the German steamship *Vaterland* (now the *Leviathan*) in April, 1917, they found havoc rampant in her engine room. Her eight huge turbines had been disassembled, many parts were missing, blades had been ripped off the rotors, valves and pipes had been smashed, and much other destruction had been done.

To restore order out of this chaos seemed well-nigh impossible; but it was the paramount duty of the United States to do so because the great carrying capacity of the ship was vital to the Allies' military plans. Fortunately, most of the damage proved less serious than had first appeared; and through the superhuman efforts of the group of expert machinists gathered together for this purpose, things were fairly ship-shape by the end of July.

Engineers Must Be Convinced

There was one turbine, however, whose condition seemed hopeless. Its rotor had broken and jammed while it was still turning, and its cast-iron casing had been fractured in 21 places. Mechanical patches proved inadequate for this repair, and the making of a new casting would have involved an intolerable delay.

The engineers in charge of the work studied the situation and finally decided to try electric arc welding.

This process, although in use at the time in steel mills, railroad shops, and some other industries, was still fairly novel, and there must have been considerable official doubt as to the success of the experiment. The trial was made, however, and four months later the *Leviathan* steamed out of New York harbor to take her place in the great conflict.

To weld by means of the electric arc, one pole of a direct-current generator is connected to the piece to be worked on, and the other is connected to a holder which carries a length of soft iron wire. The operator brings the wire into contact with the work and then withdraws it, establishing an arc. The intense heat melts the end of the wire, and molten metal drops upon the work, which also melts at the spot where the arc impinges. If the work is properly done, the result is a solid mass. In this manner, broken iron and steel castings or forgings can be repaired, cavities can be filled up, and parts can be joined together.

Will the Riveter Pass?

Dawn in a large city seems to be a signal for the start of the day's noises and soon the steady "rat-tat-tat" of the riveting gun chimes in and continues throughout the day. It appears to the average observer that cities are never finished because the work of erecting new buildings goes merrily on. So does the noise of the compressed-air riveter's hammer. However, the welding process described in the accompanying article holds forth promise of relief from this nerve-racking clamor. If city ordinances can be revised to allow other construction than riveting, we may soon have taller, stronger arc-welded buildings. ***—The Editor.***

One of the striking features of this process is the strength of the joints that can be made with it. If a box, building, or any other structure, put together by means of glue, cement, solder, nails, screws, bolts, or rivets, is stressed beyond the breaking point, it will ordinarily collapse by failing at the joints. But with the use of arc welding, structures can be made of steel plates, bars, angles, and other forms, which will be strongest at the joints and will resist pressure until the steel members themselves give way. Largely for this reason, arc welding is being employed for fabricating a wide variety of iron and steel products. So far, however, arc welding has not been generally adopted for steel building construction.

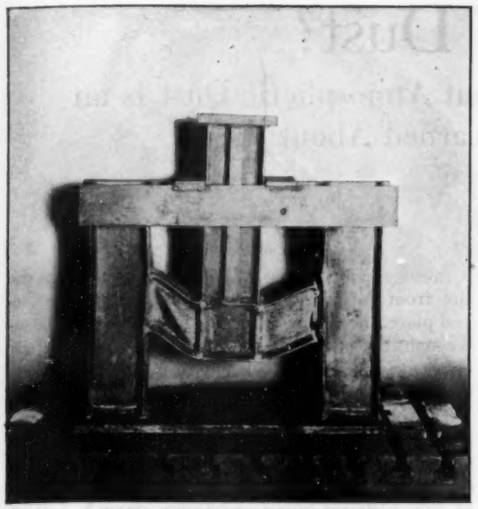
There are good reasons for this. Structural steel engineers will not consider the use of arc-welded joints until they are assured beyond all doubt as to their enduring reliability; they will not abandon the perfectly satisfactory riveted construction unless welding is proved to be more economical or otherwise superior; and they cannot successfully design structures for welding until they have complete information as to the technique of welding and the unit stresses which various standardized welded joints can safely carry.

Expected to Reduce Costs

In other words, in order to introduce the general use of arc welding for structural steel work, it is necessary to erect an "arc-welded" building of substantial size, which has been specially designed to take advantage of the economies of the process, calculate its exact cost, test the various types of welded joints employed, so as to secure full engineering data concerning them, and finally, thoroughly test the completed frame work.

Several arc-welded buildings have been erected in both the United States and England, but all of these are small structures and were put together in a more or less experimental way out of members designed for riveting. Hence they have failed to supply convincing data regarding either the reliability or the economy of arc welding and have had little influence on building construction.

In order to supply the need for an acceptable



JOINT STRONGER THAN BEAM

In this test sample, the strain broke the I-beam itself but the welded joint remained intact

object lesson, the Westinghouse Company has contracted with the American Bridge Company to erect a five-story mill-type addition to its Sharon, Pennsylvania, plant, which is to be 220 feet long, 70 feet wide, and 80 feet high, with 22 girders over an aisle 46 feet wide. The steel work was designed specifically for arc welding by Gilbert D. Fish, consulting structural engineer, and not a single bolt or rivet will be found in the completed structure.

Typical structural members to be used in this building—including girders, brackets mounted on columns, spliced beams and bars, and cantilever forms—have been assembled by both welding and riveting and tested to destruction. Without exception, the welded specimens showed higher elastic and ultimate limits than the riveted ones, the usual excess being about 25 percent, though in some cases 50 percent greater strength was developed.

These tests provide satisfactory proof that arc-welded joints are sufficiently strong for use in steel buldings. But what about costs?

If an arc-welded girder is 25 percent stronger than a riveted girder of the same dimensions, it follows that the strength of a given riveted girder can be developed by a lighter arc-welded girder.

A concrete example of the savings that can be thus effected is provided by the Sharon building. Two complete designs for the steel work for this building were prepared—one for riveting and the other for arc welding. On estimating the tonnage required for each design, it was found that, while about 900 tons of steel were needed for riveting, 800 tons would suffice for arc welding—a saving of around 12 percent in the total cost of the steel.

It is also expected that labor costs can be reduced by arc welding because it is a one-man job whereas four men are needed for riveting—a riveter, a backer up, a heater boy, and a passer. Tests indicate that the man-hours required to make the joints in a given structure by arc welding are almost half those for riveting, but the cost figures to be obtained at Sharon will be more satisfactory than any now available.

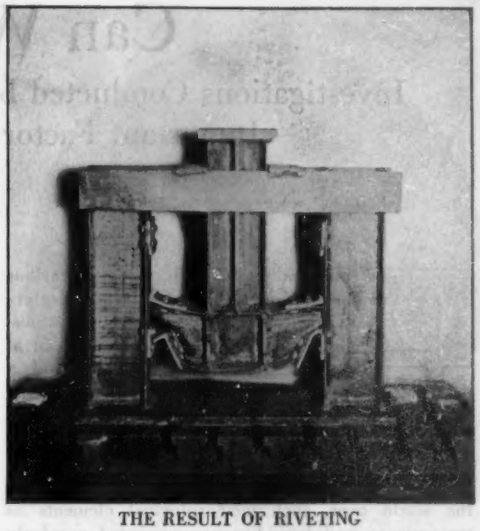
From the standpoint of the general public, the quietness of arc welding is its most appealing feature. As an example of the adverse effect of the noise of riveting, a New York hotel manager has recently stated that his hotel will lose a quarter of a million dollars of patronage during the construction of a 30-story building across the way.

Will Increase Use of Steel

Arc welding cannot now be used in city building work, however. Our city building codes are very rigid, and as all at present specify riveting for steel construction, no other method can be employed within municipal limits until the regulations are changed.

In addition to its economy, arc welding interests the structural engineer because it gives him a freer hand in building design; its permits him to take full advantage of the strength of the steel members he uses; and it enables him to obtain continuous beams of any length. It reduces the necessity for the wind-bracing of tall structures by providing stiffer joints; and it simplifies shop work and greatly facilitates alterations to existing structures.

The intense light emitted by the arc will produce temporary blindness if looked at with the naked eye for a few seconds, and it will also cause painful inflammation, identical with sunburn, if allowed to fall upon the unprotected skin. Hence the arc welder has to view his work through very dark glasses of a special formula and protect his hands with leather gauntlets and his face and neck with a sort of helmet made of some non-metallic material, which gives him quite a medieval—not to say grotesque—appearance. Fellow-workers and passers-by are protected from the light by curtains hung around the work shutting off the harmful beams.



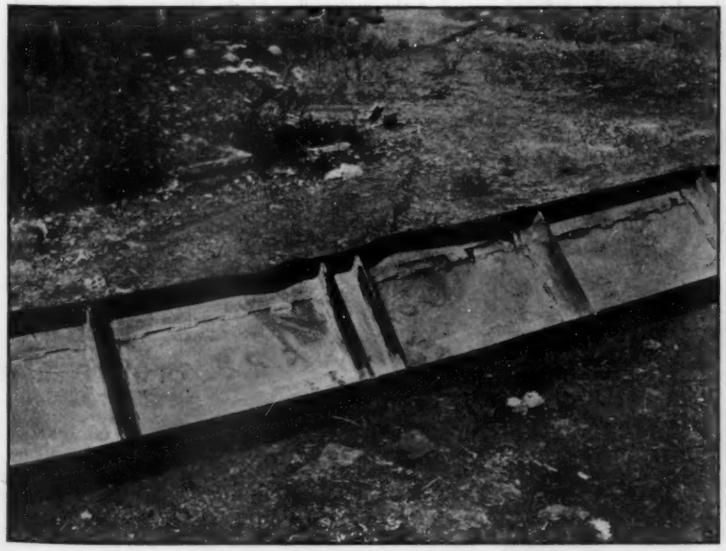
THE RESULT OF RIVETING

The destruction test on this sample caused the riveted angles to give way under the excessive strain

On the other hand, the electrical hazard of arc welding is negligible. Direct current is ordinarily employed, and the voltage drop ranges from 20 volts when the arc is on, to 60 volts when the arc is out. This voltage is too low to be dangerous, even if received at full force, and since the welder is necessarily well protected by clothing, he rarely receives even the mildest shock.

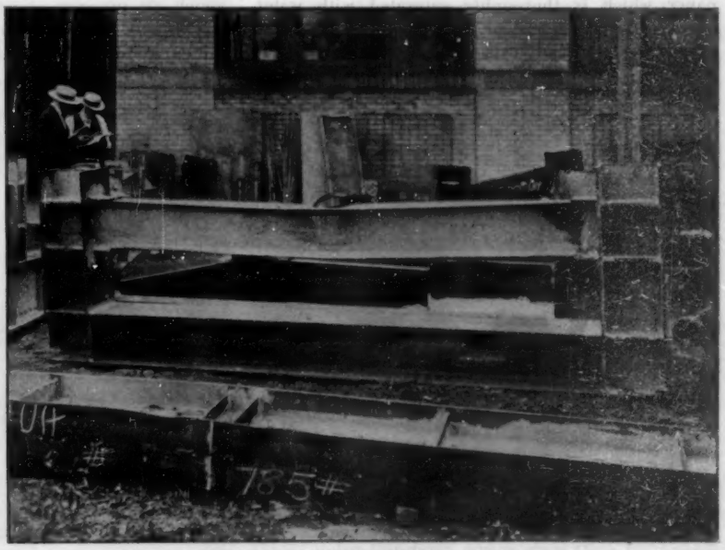
If arc welding comes into general use for structural work, it will probably increase the use of steel and doubtless bring about some radical changes in building construction. For example, the cost of constructing homes out of wood has constantly increased during the past few years, and if this continues and the cost of steel construction is reduced, the time will soon arrive when steel can be profitably substituted for wood for this purpose. This new material will give the architect increased opportunities to design for safety, comfort, convenience, and effect, and it is not unlikely that a new order of domestic architecture will come into existence.

Arc welding will also permit the erection of taller skyscrapers on given plots, and those fantastic towers, in which futuristic artists take so much delight, may some day become realities.



WHERE A WELDED GIRDER FAILED

When this building member was subjected to tests in which sufficient force to bend the girder was applied, the welded joints held and the steel plates buckled as shown



A TEST OF COMPARATIVE STRENGTHS

The yield point of a welded specimen was 50,000 pounds, ultimate load 73,500 pounds. With the riveted girder, the yield point was 42,000 pounds, ultimate load 48,700 pounds

Can We Rid City Air of Dust?

Investigations Conducted by the Weather Bureau Indicate that Atmospheric Dust Is an Important Factor in Our Lives. Much Is Being Learned About the Tiny Solid Particles in the Air

By Dorothy E. Pletcher, A.M.

OF outstanding scientific value in various meteorological tests for insuring safety in aviation is the counting of atmospheric dust by the Weather Bureau at Washington, D. C. By means of a thorough knowledge of the character and contents of the air, it is hoped that in time it will be possible to determine all air conditions before a flight and thus eliminate the present death toll claimed by the Air Service. Today, at army and navy air stations the world over, such meteorological elements as temperature and humidity are measured regularly and frequently by means of kites and balloons.

But what of visibility? Even though the aviator has foreknowledge concerning temperature and humidity, is he aware of the distances he can or can not see on a certain day? So far, he knows nothing, but science is working on an experiment that is destined to help him in some degree. Of almost equal value with the balloon atmospheric test is the counting of the particles of atmospheric dust in order to gain a knowledge of the conditions governing visibility.

Counting Dust Particles In the Air

So important is this question of the dust content of the atmosphere that at the meeting of the International Union of Geodesy and Geophysics, which was held in Rome, Italy, in May, 1922, it was decided that an international study of the problem should be taken up, and provision was made at Rome for the construction of twelve dust counters, of a kind designed by Dr. J. S. Owens of London, and for their distribution to meteorological observatories in the different countries affiliated with the union. One of these counters was sent to the United States Weather Bureau, and has been in daily use since December, 1922.

From the photograph it can be seen that the Owens dust counter has three fundamental parts. First, there is the dampening chamber, A, which is a tube open at one end and lined with blotting paper which is thoroughly saturated with water. Second, the other end of the tube is closed by a screw-threaded head, except for a narrow slot, B, one centimeter (one-third of an inch) long; and above this slot is a bed for holding a microscope cover-glass. When the end of the head is closed by the screwed plug, C, the three-claw spring presses upon the cover-glass and holds it in place. Third, a passageway leads from the space between the slot and the cover-glass to an air pump, D, by means of which air pressure above the slot may be reduced.

This reduction in pressure accomplishes two things, according to Weather Bureau experimenters; it causes the air to pass at high velocity through the slot from the dampening chamber; and, in the second place, the reduction in pressure as the air passes through the slot cools the already saturated air below its dewpoint, and moisture is condensed upon the dust particles.

The principle on which the functioning of this instrument is based is given by its inventor, Dr. Owens, as follows: "A high velocity jet of air is caused to strike a microscope cover-glass; the effect of this high velocity is to bring about a fall of pressure in the jet, accompanying which, and resulting from it, is a corresponding fall of temperature. This in turn causes a condensation of the moisture in the air upon the dust particles, which are thus projected wet against the cover-glass, and, as the water evaporates, are left behind adhering to the glass."

Dust Reduces Visibility

If air at a given pressure and temperature is suddenly permitted to expand, the temperature of the resulting atmosphere is reduced. Thus the exhaust from a compressed air tool of any kind, such as a rock drill, is always chilly. More commonplace is the opposite phenomenon, where air is compressed and therefore rises in temperature. In this case the heat which a given volume of air contained still remains with it when it is compressed, but since the volume is reduced the heat allotted to a given volume is increased. Reasoning from this, it is easy to see why moisture is condensed upon the cover glass of the dust counter when the air which has been compressed in the moistening chamber, A, is allowed to expand to normal atmospheric pressure and volume. The advantages of accuracy, simplicity, cheapness and light weight are considerations not to be overlooked in Dr. Owens' dust counter.

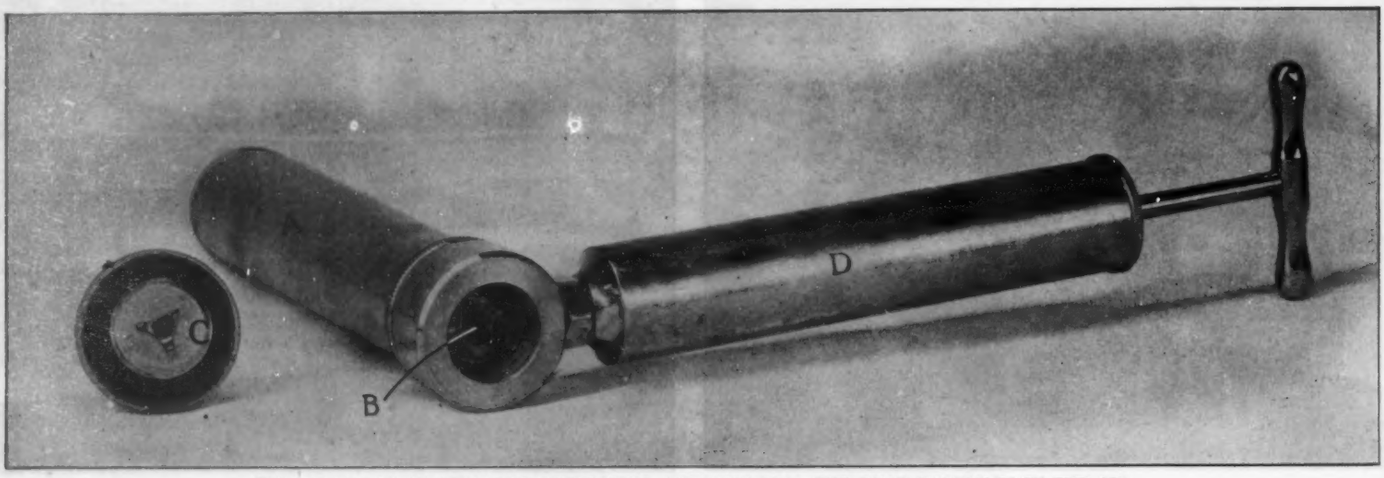
The majority of the measurements by the Weather Bureau have been made at the American University, in a suburb of Washington. The others were made at the base and top of the Washington Monument, and at the main office of the Weather Bureau, both within the city. Counts were also taken in other cities, as well as during airplane flights.

What Shall We Do About It?

What is the exact nature of the haze that nearly always hovers above large cities? What is its source? What is it? Possibly smoke is the worst offender, yet all this haze is not smoke. Instead of guessing about it, scientists have recently been studying it by definite quantitative methods. They have actually been counting the number of dust particles in samples taken at various levels of the air.

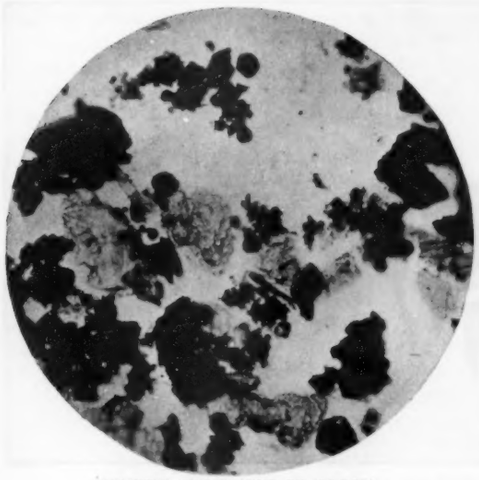
One reason why there have long been so many cases of rickets in large cities is the smoke and dust in the air. These cut off the ultra-violet rays of the sunlight, and ultra-violet light is a natural preventive of that widespread bone-deficiency disease. It is only recently that physicians have come to understand these facts clearly.

"The determining factor," says Dr. Alfred F. Hess whose researches are already famous, "is the quality, not the quantity of the sun's rays—the amount and intensity of those short ultra-violet radiations which alone are of value in preventing rickets." And, adds the noted *Journal of the American Medical Association*, "Smoke pollution robs the big cities of half to two-thirds or more of this solar effect."



THE OWENS APPARATUS FOR COLLECTING AND COUNTING THE DUST PARTICLES IN THE AIR

The component parts of the instrument are plainly shown. Air passes through the moistening chamber, A, by virtue of the action of the hand-operated pump, D. At B is placed a piece of glass, held in place by the three-fingered spring on the cap, C. Dust in the intaken air is deposited on the glass and afterward is examined



DRIVEN SNOW NOT SO CLEAN
The above photomicrograph shows atmospheric residue found in a sample of snow after it had melted

In taking dust counts from airplanes, the observers discovered that the dust counter furnished by Dr. Owens was not adapted to airplane work because of the fact that too many strokes of the pump were necessary to obtain a legible record on the cover-glass. Then too, it was found difficult to change cover-glasses between observations at the different levels on account of the high wind to which the observer was exposed. In the Weather Bureau machine shop, a dust counter with a different pump and having ten duplicate heads in which cover-glasses could be secured before flights, was constructed to eliminate this difficulty.

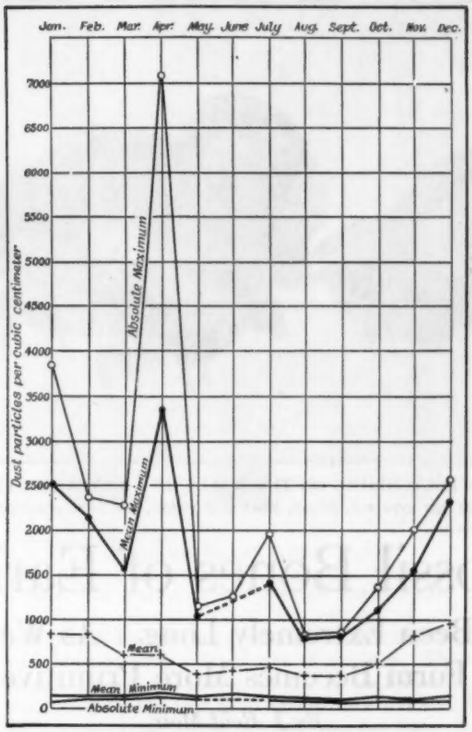
The averages of the results of dust counts taken at the American University show a marked decrease in the limit of visibility with an increase of dustiness of the atmosphere, and they indicate that the limit of visibility also decreases with increase in the relative humidity.

It has been pointed out by previous experimenters that the limit of visibility depends upon many factors, such as the intensity of the illumination of the object seen, its color, the contrast between it and its background in illumination intensity and in color. Usually, say these scientists, the background is the sky and the presence of dust in the atmosphere decreases the illumination of the object, as well as the color contrast between it and the sky, and increases the glare of light in the field of view.

What Is Atmospheric Dust?

From the airplane observer's notes it is manifest that cloudiness plays a most important part in the limit of visibility from the air. Nevertheless, it must be well noted that when the visibility from 10,000 feet was exceptionally good, the dust content of the atmosphere was less than the average.

"A summary of the results of these airplane tests," says Dr. Herbert H. Kimball, who is in charge of the dust counting experiments at the Weather Bureau, "shows at the American University an average of about 850 particles per cubic centimeter in winter, and about 400 during the summer months. The extremes vary between about 4,000, on an unusually smoky day in January, 1923, and about 100 on unusually clear days throughout the year. A comparison of December, January, and February, 1922-1923 with the same months in 1923-1924 shows an excess of over 75 percent in the number of dust particles in 1922-1923, which is attributed to a general use of bituminous coal for heating purposes at that time on account of a shortage in the supply of anthracite, and due to the fact that people were unfamiliar with the proper methods of stoking their furnaces when using soft coal, there

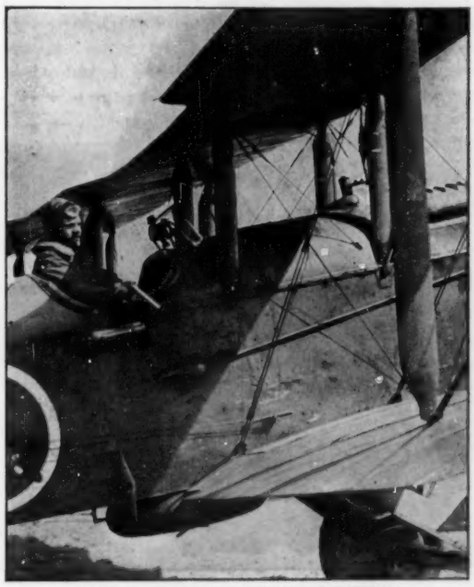


A RECORD OF ATMOSPHERIC DUST
The various lines on the above chart serve to indicate the amount of dust in the air at various times

was a smokiness to the city resembling that of this past winter—the smokiest in the history of the city of Washington."

These airplane records show that with a clear sky in the morning there is more dust near the ground and less at an altitude of between 2,000 and 7,000 feet than in the afternoon. Undoubtedly, the increase at high levels later in the day is due to convection. The cleansing effect of rain shows up distinctly in the records, while the difference in distribution of the dust in the atmosphere on clear and on cloudy mornings is clearly apparent.

It is well known that aerial haze affects photography from the air, and the results from the bureau's airplane tests show in a measure the influence of moisture and other factors as well as dust in the



USING THE OWENS DUST COUNTER
Irving F. Hand of the United States Weather Bureau ready to ascend for upper-atmosphere tests

AT THE TOP OF WASHINGTON MONUMENT
Here air was collected and the photomicrograph reproduced above shows calcite and gypsum crystals

formation of the haze in which we are interested.

According to the Weather Bureau, atmospheric dust is composed of particles so small that only a few of the larger ones can be examined by the usual petrographic methods. Finely divided mineral matter and loess comprise the larger part of the particles, while a few diatoms, spores, pollen, crystals of calcite and gypsum, and in winter, various products of combustion have been discovered.

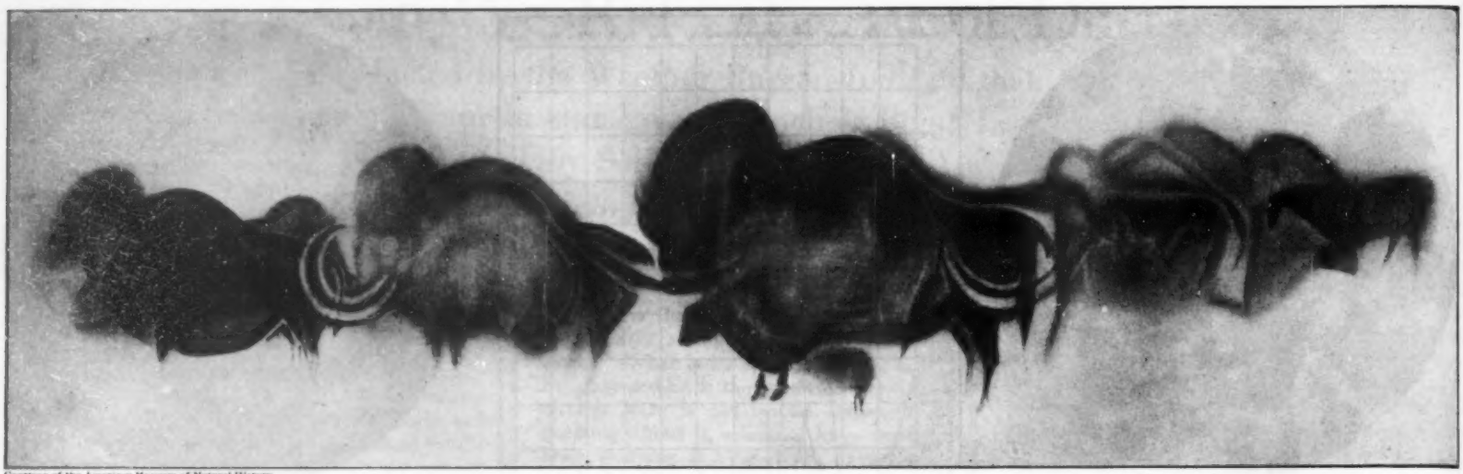
As a general rule it can be said that the average size of the particles decreases with the altitude at which they are collected. The average diameter of the particles collected at the surface is about four times that of those gathered at 10,000 feet.

Can We Eliminate Dust from the Air?

Surface visibility is a poor criterion of visibility at the ordinary levels of air navigation. After leaving the ground on a morning when objects could be seen at a distance of 20 miles or more, upon reaching a height of 3,000 feet it appeared as though the plane were flying in dense smoke and the visibility decreased to 10 miles. However, generally speaking, the higher one goes, the less dust he finds. During the experiments at Bolling Field, at an altitude of 10,000 feet, the average number of dust particles per cubic centimeter was found to be less than 50, while in summer, at 6,000 feet, which is nearly to the top of the surface haze, it is about 220.

Scientists have discovered that if air containing dust, fume, or smoke is subjected to a high tension intermittent direct-current discharge, particles are precipitated with varying degrees of efficiency. This fact was noticed about a hundred years ago, but it received no successful commercial application until Dr. F. G. Cottrell, in 1911, constructed his first plant for the recovery of sulphuric acid fume.

What will be the outcome of this exploration of the air in terms of actual value to aviation, navigation and science in general? As a result of Dr. Kimball's and Mr. Hand's investigation of the atmosphere, it is being made undeniably clear that the next step should be an attempt to rid the air of the cities to as great an extent as possible, of extraneous dust particles which we now know affect both visibility and public health. Various public health services have written to Dr. Kimball, asking for his cooperation in studying the dust content of the atmosphere and its effect upon public health, while aviators and navigators the world over are thankful for this boon which gives them foreknowledge of atmospheric conditions, so that in the future they will not be so dependent as heretofore upon mere winds of chance.



Courtesy of the American Museum of Natural History

MURAL FRESCOES OF ANIMALS, DRAWN IN POLYCHROME ON THE WALLS OF A CAVERN IN FRANCE BY ANCIENT CRO-MAGNON ARTISTS

The colors employed by these priest-artists of 18,000 years ago were red, brown, black and yellow, and were obtained from iron ochre, oxide of manganese and other minerals

The Fossil Bones of Early Man

Man's Life on Earth Has Been Extremely Long. As We Trace It Back His Bodily Form Becomes More Primitive

By J. Reid Moir

Fellow of the Royal Anthropological Institute

THERE is no doubt that, as compared with the vast number of flint implements found in ancient deposits throughout the world, the discoveries of the bones of the human beings who made these implements are exceedingly rare.

It is, of course, only to be expected that his flint implements would be numerous because, in the first place, every prehistoric man must have made a great many in his lifetime—as do primitive people of the present day—and secondly, these specimens are practically indestructible, and so have survived the drastic vicissitudes of the past.

On the other hand, the comparative scarcity of ancient human bones is not a very surprising fact, since the population of early prehistoric times could not have been by any means large. Further, it is probable that when an individual died, his body was left out in the open to decay, or to be eaten by carnivorous animals. The fossil bones of man that are found in ancient gravel beds and other water-laid deposits, are almost certainly those of people who were drowned, or whose bodies, left lying in the open, were swept away by floods and buried in the gravel and other deposits which were then being formed. Although the precious remains of man are therefore rare, yet enough of them have been found to enable us to form a clear idea of the type of people who inhabited this earth in remote times.

A Skull Both Human and Ape-like

There cannot be any question that as we go back into the past, the type of man becomes more and more primitive, and shows an ever-increasing similarity to those of the higher apes. Although the existence of man at any given period can be proved with certainty by the finding of his flint implements in the deposits of that period, yet the discovery of actual human bones is always regarded as a crowning triumph of research in prehistoric archaeology, for it sets the seal of certainty upon the previous finds of his flint implements. In this article I propose to describe to you some of the more important discoveries of human fossil bones that have been made, and to show their great antiquity.

About thirty-five years ago, a remarkable discovery was made in Java by Professor Dubois, who had been sent out by the Dutch Government to explore certain deposits in that island, which were known to be very rich in the fossil bones of animals. Fortunately, these researches resulted in the discovery of the upper portion of a skull, the thigh bone, and two teeth of a creature that evidently possessed both human and ape-like characteristics. The discoverer of these remains gave to them the name of *Pithecanthropus erectus*, or the "erect-walking man-ape." There can be no doubt that this title is correct. The skull cap shows marked ape-like features —a great projecting, bony ridge over the eye-sockets and an almost non-existent "forehead"—while the inside capacity of the skull has been shown to be intermediate between the highest apes and the lowest type of man. Although the skull cap exhibits these remarkable characteristics, the thigh-bone and teeth, which must be referred to the same individual, approximate very closely to those of modern man.

From Moir's "The Great Flint Implements of Cromer"

AN EARLY PALEOLITHIC FLINT

This seven-pound, ten-inch implement was made in the days of the first glacial stage—500,000 years ago

Thus we see that in this Javan discovery there is placed before us a creature possessing both ape-like and human resemblances. The exact geological age of this fossil has been in dispute, as is often the case with the remains of ancient man, but it belongs either to the close of the Tertiary, or "third" geological period, or to the beginning of the Quaternary, or "fourth" period; and it is quite likely not far from one-half million years old.

Another very important find—that of a human jaw-bone in fossilized condition—was made in 1907 at Mauer, near Heidelberg, in Germany, at a depth of about 90 feet from the present surface of the ground. The geological age of this specimen is well known. Judging from the nature of the animal remains found with it, it is clearly of the same period as that of the Cromer Forest Bed of Norfolk, from which I have obtained a large number of flints flaked by human hands.

Ape-like Jaw, Human Teeth

The Heidelberg, or Mauer, jaw-bone is a most impressive relic of early man. Not only is its antiquity profound, but its massive size and brutal appearance at once rivet the attention of anyone examining it. The specimen shows no sign of a chin, and the ascending rami (those portions of the jaw which branch upwards from behind the rear-most molar teeth) are of extraordinary width and strength. It is obvious that the being who possessed a jaw-bone of this character must have been almost of gorilla-like proportions. In fact the jaw-bone itself, if the teeth had been missing, would have almost certainly been regarded as that of an ape. But nearly all the teeth are present, and these are of a definitely human type.

Thus, in the Heidelberg jaw-bone we see again a combination of human and ape-like characters.

We turn to a discovery made at Piltdown in Sussex, England, some years ago, by the late Mr.

Charles Dawson of Lewes. When visiting a shallow pit where gravel was being raised, he obtained from a workman some portions of a very thick and fossilized human skull. This important find induced him to conduct diggings in the same gravel pit, and eventually half of a lower jaw-bone and a large human canine tooth were discovered. The gravel in which these remains occurred is not far from the valley of the River Ouse in Sussex, and is evidently a very ancient deposit. Unfortunately, the gravel is not of great depth, nor is it covered by any other bed which would enable us to "date" it geologically. Thus, the exact age of the Piltdown deposit, though unquestionably very ancient, is not known; but the flint implements found in the same deposit of gravel are of very early types such as we know occur in beds of the Late Tertiary and Early Quaternary periods in East Anglia.

The Original "Cave Man"

The skull and jaw-bone, which have been described by Dr. Smith Woodward, and by Sir Arthur Keith, show us once more an individual with both human and ape-like characteristics. The skull is of definitely human form. It shows no trace of the projecting ridge above the eye-sockets, such as is so prominent a feature in some early types of man. The bones of this skull are very thick, but otherwise in its general outline there is nothing very ape-like about it.

But when we turn to the jaw-bone we see a very different picture, for it possesses many ape-like characters. There is the usual absence of a chin, and the whole aspect of the specimen is very primitive. The most outstanding peculiarity of it is the canine teeth, which stick up above the level of the others, in the same way in which the ape's canines project. Never before has a human being been known with a definitely human skull, and with jaws showing canine teeth of this kind. Thus, the Piltdown discovery is of great importance and interest to all those who are interested in man's ancestry.

It is possible that those fossil remains which I have described, namely, those of Java, Heidelberg, and Piltdown, lived during the warm climatic phase intervening between the first and second glacial phases and are possibly 500,000 years old.

We must now pass on to a later epoch, when the third glacial episode or ice invasion was commencing and western Europe was peopled by a strange

Courtesy of the "Illustrated London News"

A COMPARISON OF THIGH BONES

LEFT: *Modern man.* CENTER: *Java ape-man.* RIGHT: *Gibbon. The center bone most resembles that of a man*

race whose remains have been found in caves and rock shelters over a large area of country. These human beings are known by the name "Neanderthal," because the first skull of this race was found in a cave in the valley of the Neander River in Germany. A very great deal is known of these early people because several nearly complete skeletons of them have been found. These finds clearly represent ceremonial burials—the oldest intentional interments as yet discovered.

The Neanderthal race used very characteristic and well-flaked flint implements, and was associated with a large number of cold-loving animals whose remains have been found in the deposits of the period during which this race lived in Europe.

The skulls of these people were very long and thick, and had a great bony ridge extending across the eye sockets. The Neanderthal people had massive jaws and teeth and short, thick limb bones. An examination of the leg bones of this race shows that they probably walked with a slouching gait, and from the position of the *foramen magnum* (the aperture at the base of the skull through which the spinal cord passes to the brain), it is concluded, that they carried their heads projecting forward.

So far as we know, the Neanderthal people eventually became extinct; but their bones tell human anatomists a wonderful story of one of the ancient types of man that inhabited Europe in remote prehistoric times.

Before the Neanderthal race entirely disappeared, a new and much higher type of prehistoric hunters had entered western Europe, bringing with them a hitherto unknown culture. These newcomers were remarkable people, for not only were they quite "modern" in their bodily form but they were artists of no mean ability—as the drawings, sculptures, and engravings of animals they left behind them in their old camping places, so vividly show.

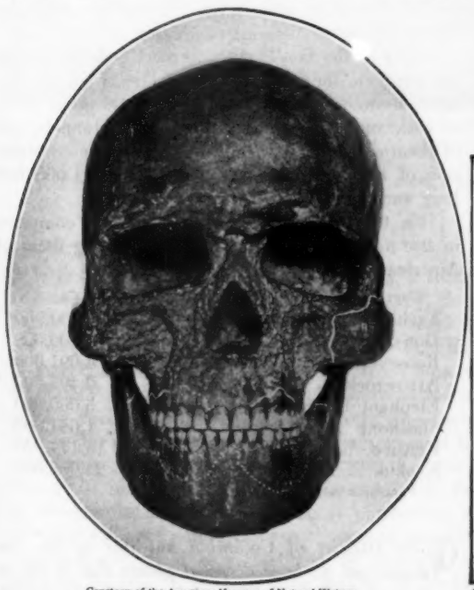
The first discovery of skeletons of this race was made in the rock shelter of Cro-Magnon in France, where they had been buried. It revealed a type of individual of commanding height, long-headed, and with jaws and limb bones comparable to those of the highest races existing today. Indeed, my friend, Sir Arthur Keith, has likened them to the Sikhs of India, while others, because of their artistic powers, have called them "the Paleolithic Greeks."

Neanderthal Man Not Our Ancestor

The origin of the Cro-Magnon people, as they are called, is somewhat obscure; but it is clear that they could not have developed from the primitive Neanderthalers. Therefore, their ancestors must be looked for in pre-Neanderthal times, and it is probable that the well known Galley Hill, St. Denis, and other discoveries of human bones of modern type in very ancient deposits represent these ancestors. There would thus seem to be no doubt as to the great antiquity of the modern type of man of which the Cro-Magnon people of about 30,000 years ago were such splendid physical examples.

The fact must be emphasized that the Neanderthal race cannot be regarded as the ancestors of modern man *(Homo sapiens)*. It would appear that, possibly, the cold climate conditions obtaining in Europe in middle Paleolithic times favored the sturdy Neanderthalers, and enabled them for a considerable period to dominate western Europe. But, both in their physical structure and in their flint implements, they represent a very early and primitive type of mankind.

In this short survey I have mentioned merely a few of the discoveries that have been made of ancient human bones; but even this evidence is, I think, sufficient to carry conviction as to the great antiquity of man, and that, as we delve into the very remote past, we find human types becoming more and more primitive, approximating in their bodily form to that of the higher apes.



Courtesy of the American Museum of Natural History

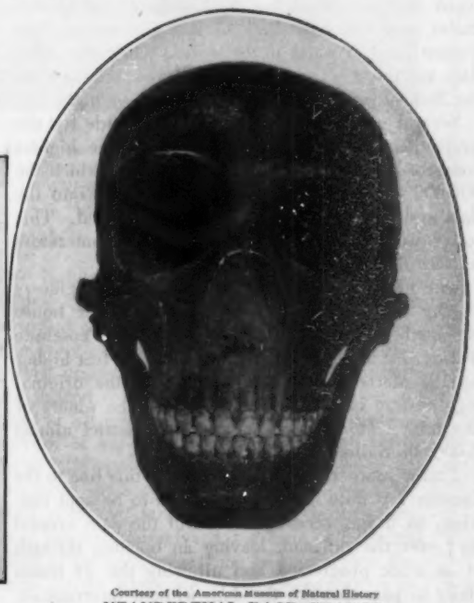
THE "OLD MAN" OF CRO-MAGNON

Some say there were three Cro-Magnon races—Caucasian, Mongoloid, Negroid. Others claim all were one people

Courtesy of the American Museum of Natural History

GRIMALDI NEGROID YOUTH

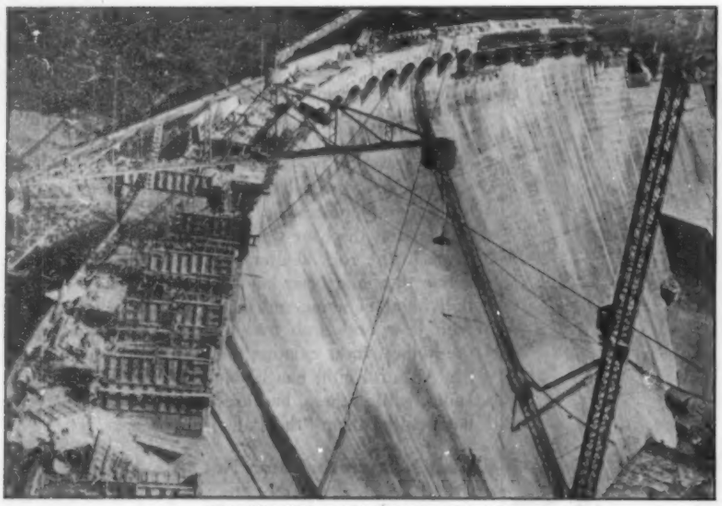
Skull from a cave on the shores of the Mediterranean. Did part of the Cro-Magnard negroids come from Africa?



Courtesy of the American Museum of Natural History

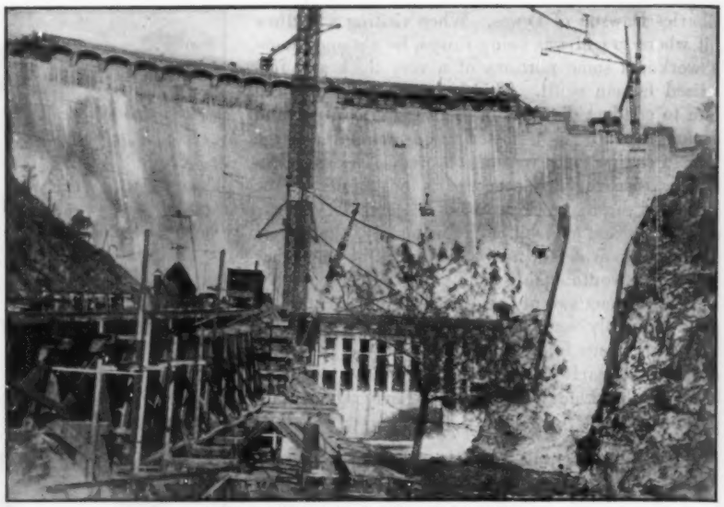
NEANDERTHAL RACE, FRANCE

Neanderthal man lived both before and during the last stage of the Ice Age. Cro-Magnon man exterminated him



EXCHEQUER DAM FROM THE AIR

This view was taken from one of the cables that ran 400 feet above the bed of the stream. The concrete-hoisting tower at the right is the highest of its type in the world



A VIEW FROM THE MERCED RIVER

The power-house is in the background and the giant hoisting tower shows beside it. The tunnel at the left is that through which trains ran until completion of the dam

Latest Lofty Dam in California

Dam, 330 Feet High, Impounds Sufficient Water to Cover 289,000 Acres One Foot Deep

EXCHEQUER dam, irrigation and power project of the Merced Irrigation District, Merced County, California, to cost 15,000,000 dollars, and said by its engineers to have been the largest work of its kind under construction in the world at the time, was completed this spring and is now storing water.

The dam, situated on the Merced River in the Sierra hills east of Merced, is 330 feet high, 960 feet long, 220 feet thick at the base, and 16 feet thick at the top, and will store 289,000 acre-feet of water. It will also make possible the generation of 42,000 horsepower of hydro-electric energy. Back of the dam a lake 12 miles long and an average of 106 feet deep is formed and approximately 91,000,000,000 gallons of water is available for irrigation and power purposes.

Exchequer dam is unique in that it is higher than seven out of eight of the great dams of the United States, and will have back of it, engineers say, the highest head of water in the world. Only one other dam in America tops it, that is Arrowrock dam on the Boise River, Idaho, which is 349 feet high.

Several other interesting claims are made for the project, among them being the use of the highest concrete hoisting tower in the world, with which the 396,000 cubic yards of concrete that went into the dam and power house were raised and placed. This tower was 475 feet high and cost the contractors no less than 500,000 dollars.

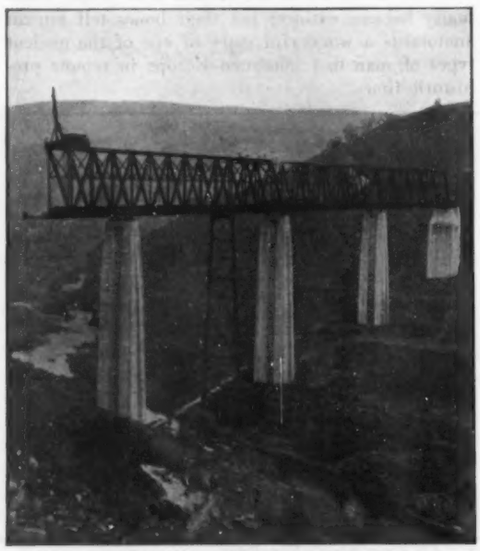
One of the distinct problems faced by engineers in the construction of the dam and power house was the fact that 17 miles of railroad of the Yosemite Valley line had to be relocated some 300 feet higher up the Merced River canyon, because the original right-of-way is now being covered by the waters of the lake. This feat alone cost the district almost 5,000,000 dollars.

Furthermore, trains which run over this line to the famous Yosemite National Park had to be kept running, so it was necessary to build the dam around and over the railroad, leaving an opening through it as work progressed and allowing the 24 trains daily to pass through the dam without interruption. The tunnel thus formed was filled as one of the last bits of work connected with the project and trains are now running over the upper and relocated line.

The following facts will give a better idea of the size of the project:

Area of reservoir, 2,721 acres.
Depth of water at dam, 315 feet.
Total capacity, 91,000,000,000 gallons.
Annual discharge of river at dam, 960,000 acre-feet.
Excavation for foundations of dam, 97,000 cubic yards.
Total concrete, 396,000 cubic yards.
Radius of arch of dam, 675 feet.
Weight of penstock and sluice pipes, 622,000 pounds.
Weight of valves and gates, 1,100,000 pounds.

The valves and gates for regulating the flow of water include two 48 by 60-inch high pressure slide gates; two 75 by 96-inch high pressure slide gates; two 96-inch inlet diameter penstock valves; two 96-inch inlet diameter, free discharge needle-type valves; and two 60-inch, inlet diameter, free discharge needle-type valves.



PARTIALLY COMPLETED BRIDGE

This bridge, 1,600 feet long and 236 feet high, was built for the relocated Yosemite Valley Railroad

Spillways for the dam are of the overpour type into concrete channels, with a crest length of 336 feet and a capacity of 75,000 second-feet of water.

Power house equipment is as follows: Two 15,625-kilowatt 11,450-volt three-phase, 60-cycle, 257 revolutions-per-minute generators, with a maximum capacity for the plant of 42,000 horsepower using 1,500 second-feet and two variable-head, cast-steel case, 257 revolutions-per-minute turbine water wheels.

The power house output annually is 120,000,000 kilowatt-hours which the district has already contracted to sell to a California power corporation for 4½ mills per kilowatt-hour or about 540,000 dollars a year.

While construction work on the dam and power house proper was completed on schedule, completion of the entire project was delayed somewhat by the relocation of the railroad.

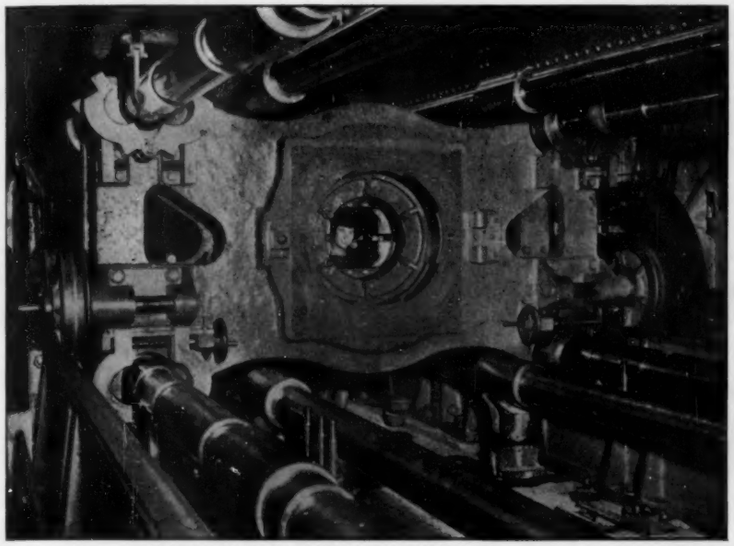
Owing to the fact that the project is in mountainous country, the relocation of the railroad necessitated the movement of almost 2,000,000 cubic yards of rock and earth, the drilling of four tunnels, one of them a quarter of a mile long, and the construction of three steel bridges, one of them 1,600 feet long and 236 feet high.

This table shows how Exchequer dam compares in size and cost with some of the other big dams of America:

Dam	*Height*	*Length*	*Cost*
Exchequer	330	961	$15,000,000*
Don Pedro	283	1,040	4,000,000
Roosevelt	280	1,125	4,091,000
Arrowrock	349	1,100	4,497,000
Elephant Butte	306	1,674	5,000,000
Shoshone	328	200	1,671,000
Kensico	307	1,825	15,171,000
Keokuk	53	4,360	24,000,000

* Includes relocating railroad.

¶ The District of Columbia has one of the few municipal garbage disposal plants that is run at a profit. How the refuse is turned into salable oils and greases is an interesting story that will be told in an early issue.

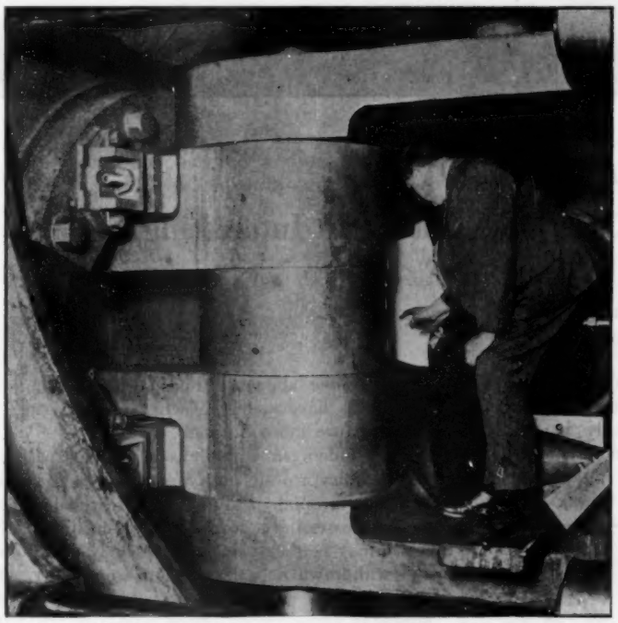


THE MOVABLE TENSION CROSS-HEAD

This cross-head is equipped with grips for holding the specimen which is being tested in tension. This cross-head moves slowly away from the reader, being driven by a powerful hydraulic ram which pulls on the specimen

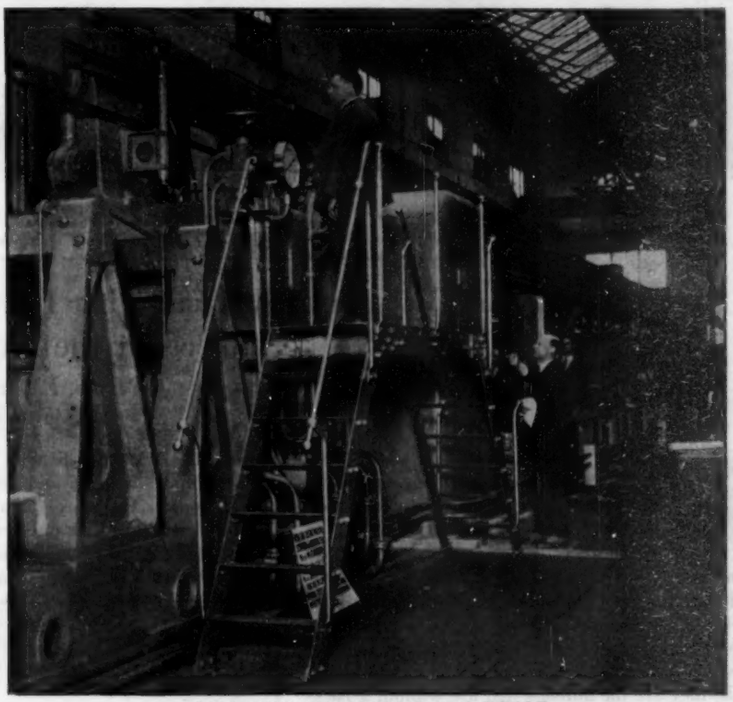
SNAPPING BIG STEEL CABLES LIKE THREAD

The editors of The Engineer *inspected the machine and saw it break a wire rope 2¾ inches in diameter, under 240 tons tension. But this was mere child's play for the great machine*



SHACKLE WHICH TAKES THE WHOLE STRESS

If the specimen under test suddenly gives way there is a considerable recoil due to the elasticity of the various parts of the machine. In designing the shackle this point had to be considered in order to avoid disastrous results



THE MAMMOTH MACHINE AS A WHOLE

Its overall length is 120 feet and it stands 13½ feet above floor level. It will take specimens up to fifty feet long and 12 inches by 3 inches cross-section for tension members and up to 45 by 45 inches for compression. For transverse bending the maximum span is 20 feet

Giant Testing Machine Pulls 2,800,000 Pounds

A huge testing machine capable of exerting a force of 1,250 long tons has just been completed in Birmingham, England, primarily for testing parts of the immense arch bridge of 1,500 feet spans that is now being built across the harbor of Sydney, in Australia. Our British contemporary, *The Engineer*, states (July 30, 1926) that "from time to time efforts have been made in America to test to destruction full-sized members of bridges and other structures, with the object of verifying the designer's calculations; but, so far as we are aware, the apparatus used in these tests was rather crude and neither allowed of a graduated load nor of a precise determination of its magnitude. There is, however," *The Engineer* continues. "now in this country a machine capable of performing all the tests required by a bridge designer with great exactitude and convenience." Does the above statement not stand as a challenge to American engineering? The new machine is said to be easily the largest of its kind, capable of pulling apart a steel bar over six inches in diameter. The required tension and compression stresses are applied by means of a hydraulic ram 32 inches in diameter with a stroke of 66 inches. To this ram water is supplied at a pressure of up to two tons per square inch. Since the most important lessons to be gained from the testing of large specimens for various structures, such as bridge girders, posts, tie rods, and so on, result from their actual observation and study while undergoing gradual destructive test, the machine was built horizontally instead of vertically. Hence, a clear view of the test specimen may be had at all times. The amount of the load is measured by means of a steelyard at one end. The full stress of 1,250 tons (presumably the long ton of 2,240 pounds usually employed in Great Britain) is carried by the massive shackle shown above. It must be measured with a high degree of accuracy, large as it is. It is therefore balanced against a weight of one ton on the steelyard, the ratio of leverage being 1 to 1,250. As the loading of the knife-edge must be kept within the limit of five tons per lineal inch (if the edges are to remain edges), it is obvious that the edge would have to be 20 feet long! Since so long an edge would be impracticable the load is divided between four levers.

Classifying the Arthropod

This Sub-division of Animals That Have No Bones Makes an Interesting Subject for the Nature Student

By S. F. Aaron

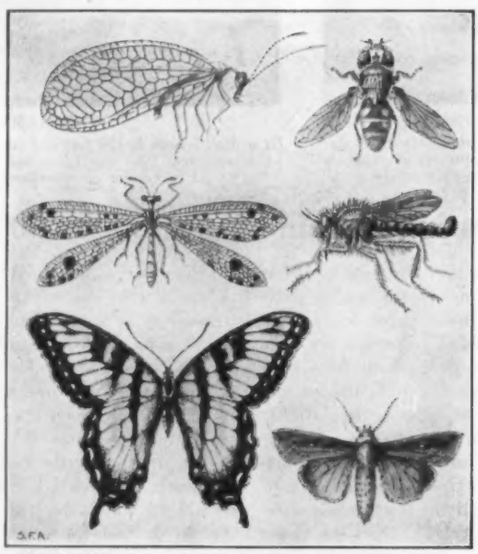
Drawings by the author

IT would be an aid to nature study if the term "arthropod" were as commonly used, as familiarly accepted and as well understood as the words insect or spider, reptile or bird.

The definition of arthropod is as easily comprehended as any term that refers to a group of animals or plants. It includes all that largest sub-kingdom of organic creatures that have a segmented exoskeleton and locomotory appendages. In other words, they are the animals that are without a backbone or any bones at all, strictly speaking, their bodies being encased in a ringed, exterior tegument and having legs and, sometimes, wings. In this great division is included the crabs, lobsters and shrimps as one class, the spiders, mites and scorpions as another, the millepedes and centipedes as the least numerous group and the insects which in numbers of distinct forms or species exceed all other animals and plants combined.

Thus the arthropods, considering their varied and extensive development, comprise the largest branch of the evolutionary tree, springing most probably from the ancestral forms of the annelids, or true worms, the latter falling far behind in the effort to meet successfully the widely different and changing influences of environment.

There are more extreme differences in the forms, habits and behavior of the arthropods than are to be found in any other division of the animal kingdom of equal importance, as the classificationists see it. Without giving much attention to the narrow distinctions of the systematists, it is nevertheless essential that we understand those major variations and peculiarities without which we could not draw comparisons and would be at a loss to find distinctive appellations. Therefore, a butterfly is an insect because it is divided, or insected, more completely—head, thorax and abdomen—than spiders and crustaceans, which have the head and thorax all in one and only the abdomen attached by a stem. The millepedes have merely a series of even rings and are therefore more distinct.



COMPARISON OF MUSCLE AND WING STRUCTURE

The insects on the left, the golden-eyed fly, ant-lion fly and swallow-tailed butterfly, are among the weakest aerial performers. Those on the right, the bee-fly, robber-fly and noctuid moth of the army worm are among the swiftest of all winged creatures

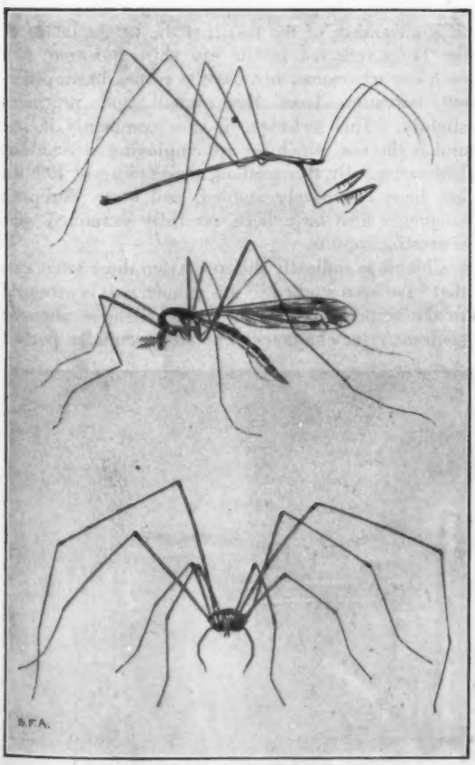
The spiders show less variation than all other groups; they are all carnivorous, are the most agile of all arthropods and the least affected by cold, though possessing a low vitality from direct injury. A pin may be thrust through the body of a butterfly and withdrawn and the creature apparently suffers little inconvenience beyond an occasional, temporary muscular constriction. Even with the pin left in place, the highly organized insect will enjoy a repast of flower nectar. Thrust a pin into a spider only a little way and the creature dies immediately. The nervous and sensitive organism of arthropods prevents them from experiencing actual pain, as is also true of the lower forms of the vertebrates.

The eyes of the arthropods have become a means of classification. Because of their great variation and complicated development in many forms, it might seem that they had also reached a high state of optic perfection, as is the case with the eyes of cats, certain rodents and many birds. But this is not so. The range of vision is never over ten feet, generally much less than that and often but a few inches. Although the observation of movement, commonly by the reflection of light, is of great use in determining the attack of an enemy, or more rarely, the swift presence of a mate, there is almost a total lack of recognition of form, as may be frequently noted. A winged insect will alight on any stationary object—a butterfly net, the collector's hand, the head of a snake or within a few inches of an insect-eating bird. Bright contrasts of color are

discerned, as is also reflected light when not moving, but for the most part, the true nature of nearly all objects is made known by odors. It would thus appear that the ability to detect with astonishing accuracy the most delicate odors, and these at long distances, has become a more easily effected matter of extreme development than a discriminative optic nerve; yet this is the more strange when the differences of transmission between rays of reflected light and odoriferous particles are considered, the latter depending largely upon the wind. It is not only and chiefly a matter of discrimination, but one of comparative sensitiveness. Certain sexual odors bring winged insects for miles, while the extreme attractiveness of artificial light has a very limited range. These facts are fully proved.

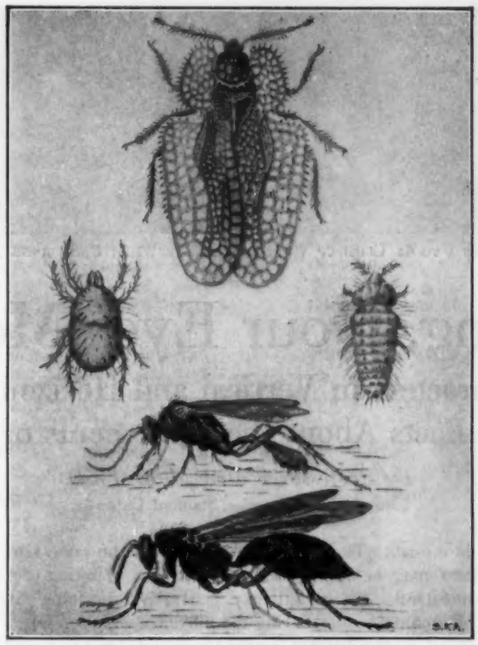
A simple experiment is the placing of a brightly colored imitation flower among actual blossoms, the colors not necessarily agreeing. Many nectar-seeking insects, notably the butterflies and bee-flies, will visit it, though remaining only a fraction of a second. Thus the bright hues of flowers contrasting with the foliage do aid, although in a minor way, to guide insects to them for purposes of fertilization; yet all these lovers of sweets are even more eager to visit molasses smeared on tree trunks and the dripping of honey-dew than to seek the most delectable and brightly colored flowers.

Although showing considerable variation, being thread-like, clubbed, pectinate, feather-formed or branched, the antennas of the arthropods, which are almost their sole means of detecting odors and of determining the direction from which they emanate, are not of class distinction, but give character to orders and families of nearly all groups. Legs, and the thorax supported by them, constitute the chief differences of major value in identifying the four classes of the arthropods: the Crustacea and Arachnida, having eight legs attached to a cephalothorax; the Millepedes, having almost as many legs as the numerous body rings which include the thoracic and abdominal organs, and the insects with but six legs—whence the name Hexapoda. The latter constitutes the only class that possesses wings, although there are many apterous forms.



LONG-LEGGED INSECTS

TOP: *A stilt bug.* CENTER: *A giant crane fly.* LOWER: *A pedipalpi, commonly known as "daddy-long-legs." This insect surrounds and holds its prey with its long legs and then proceeds to kill it. Illustrations about full size*



SEVERAL FORMS OF ARTHROPODS

TOP: *A lace-winged bug, one of the extremes of exoskeleton forms, much enlarged.* LEFT CENTER: *A mite, one of the simplest of arthropods, greatly enlarged. The mite is of the spider class.* RIGHT CENTER: *A springtail, one of the simplest of the true insects. Shown about four times natural size.* CENTER: *A parasitic wasp, in life no larger than a pin head.* LOWER: *A digger wasp, natural size*

There is little variation in the general construction of arthropod legs; all consist of five distinct parts, but the tarsi, generally of five joints also, are, in the simpler forms, of two and three joints. Length and relative size as denoting strength are the chief differences. Running speed bears little respect to number or size, but for leaping, the femora are always thickened for the additional muscular development.

"Thousand-legger" Has Only 220 Legs

The terms centipede and millipede are, of course, extreme exaggerations; the other group of entirely carnivorous forms are rapid-running and possess commonly from twenty-six to forty-two legs. The "thousand-leggers" have as many as 220 legs, two pairs operating from each of the body segments, with the exception of the three posterior rings. These creatures are slow of motion and vegetarian. Allied to these are the sow or pill-bugs, so called, which have 14 legs attached to the thoracic rings.

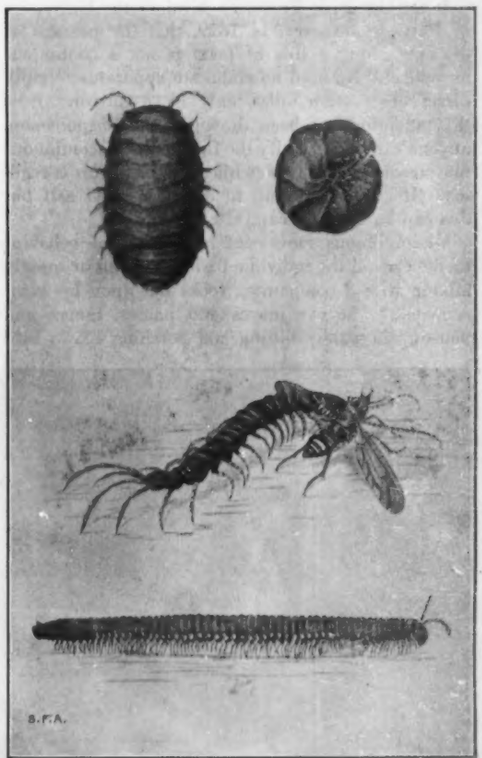
Extreme length of legs is of importance as a means of protection against savage, shorter-legged enemies, or, in predacious forms, as a sort of encompassing cage to prevent the escape of smaller prey. Thus, "daddy-long-legs" (pedipalpi), in making ready to pounce upon a leaf beetle or lethargic fly, surrounds it with drawn-in legs and then swiftly lowers its body upon the victim.

The number, shape, size and venation of the wings are factors governing the classification of the insects. Invariably the relative power is governed by the muscular development in proportion to the wing area. Thus, all the swift-flying species have stout bodies and small wings, while nearly all the slow or indifferent fliers, among the latter being those that merely support themselves in air and drift with the breeze, are forms with slender bodies and comparatively large wings. There are some exceptions among the heavy-bodied forms, as notably the plant lice which have their muscles crowded out by the digestive and genital organs. Also, some beetles are endowed only with great leg power. Among the butterflies, the geometrid moths and the true Neuroptera, there are large-winged species that have also great muscular power, enabling them to fly moderately fast, with excellent control.

Size in general is of little importance with regard to the characteristic form or habits of any species. Certain families of all the classes are all very small or quite gigantic; others possess genera and species of both extremes. We are inclined to regard those forms demanding the use of the microscope as possessing simple organisms, finding this in the protozoa and in such vegetation as the bacteria. Among the Crustacea and Millepedes there are none that are exceedingly minute, except when hatched out, but the insects possess many forms that are microscopic in all orders and the mites belong to the Arachnida.

We are also prone to regard microscopic creatures as relatively simple with regard to mentality. It almost seems, at first thought, as though choice, memory, recognition of circumstances and attendant mental processes that are shown by many of the more highly developed insects would require a brain large enough to receive and record these complex impressions. However, the most minute Hymenoptera and Diptera are not only similarly constructed physically throughout, but also show habits similar to and as remarkably complex as closely related forms a hundred times larger. Thus the tiny wasps, no larger than a pinhead and that are parasitic on aphids and spider eggs, might be compared in size with the big ichneumon wasps, like a shrew unto an elephant.

¶ One of the unrivaled "wonders of the commonplace" is the tiny snow crystal, too fine in detail to be seen unaided. By a painstaking technique, these have been photomicrographed. The method used for this work and results obtained will be described in our December issue.



MULTI-LEGGED ARTHROPODS

TOP: *Wood-louse or pill-bug (not a bug at all), that rolls itself up like an armadillo. Its technical name is Armadillidium.* CENTER: *Woodland centipede killing a bee fly.* LOWER: *Millepede or so-called "thousand legger"*

FIGURES 1 TO 4: CLOSE-UP VIEWS OF THE EYE WHEN UNDERGOING TESTS

When Reading, Your Eyes Move in Jumps

Tests With Chinese Characters in Vertical and Horizontal Lines Disclose Some Remarkable Facts About the Movements of the Eyeball

By Professor Walter Miles, Ph.D.
Psychology Laboratories, Stanford University

SOME ancient Chinese as he sat reading with his fingertips resting lightly about his eyes and on his forehead, may have noticed, through the sense of touch, the peculiar jerking motion of the eyes as he scanned a line of characters. Considering the fact that the eyelids follow the movements of the eyeballs, promptly responding as the line of vision is raised or lowered, the reading of symbols arranged along a vertical line would offer a good opportunity for making this observation.

Chinese characters have traditionally been arranged in vertical lines to be read from top to bottom, starting in the upper right-hand corner of the page, and proceeding with successive lines to the left. But so far as our scientific world is aware, no Chinese, and we may say also, no Egyptian, Greek or barbarian, ever recorded the fact that the eye goes in little jumps when reading.

It remained for Professor Javal of the University of Paris, to discover, in 1879, that the passage of the eyes along a line of print is not a continuous movement. He used no elaborate apparatus; simply direct observation aided only by a mirror. Now that attention has been drawn to the phenomenon, anyone can easily verify the fact of the discontinuous movement by closely watching a person who is reading. It is more difficult to detect in one's self but this can be done by careful observation.

Discontinuous movement is the typical behavior of the eyes in the individual who, walking or quietly talking with a companion, looks out upon his environment. The eye moves and pauses, moves and pauses, alternately flitting and perching like a bird in a bush. The movements are not of the same size, and may be in any axial direction. Winking, for moistening the eyeball and generally "servicing" it, commonly occurs during the movement phase. Often there is the further complication of an associated head movement.

If we think of the eye as a camera and if there are to be clear images on the retina, it must have moments of stationary position. Blurred images would result at the time of movement unless the object of vision and the eyes moved at a corresponding rate. A chicken or a pigeon that is walking is observed to move the head in a jerking manner. By so doing, moments of stationary position are secured for the eyes, with the result that relatively unblurred vision is obtained while the body is continuously moving. The pauses of the human eyes are really quite brief, but "mere glances" though they be, they constitute the real times of "seeing" and have much greater duration than have the movement phases. The method of proving this is described below.

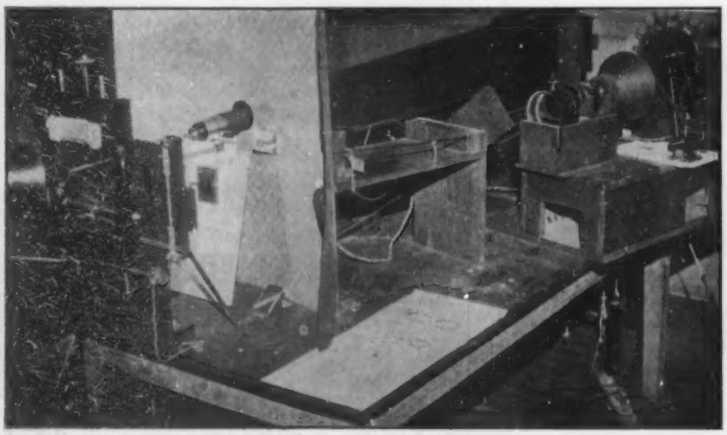
Chinese a "Two-dimensional" Language

Perhaps it has always been implicitly assumed that the eyes perform discontinuous movement in reading as in all other observing of stationary objects. Professor Javal's discovery was, however, not limited merely to establishing this point. His work was of importance because it revealed the characteristics of mental perception. He found that the number of pauses in reading a line was not very great—only about half as many as there were words in the line. This was a discovery indeed. According to this individual, letters were not seen as such; words and even groups of words were grasped as wholes.

This field of inquiry, once opened up, was entered by a number of investigators, and has been chiefly worked by Americans. Tracing levers were devised to be attached directly to one eye by means of plaster of Paris or ivory cups. These devices gave permanent records on smoked paper, but had their disadvantages, not to mention dangers, to those who served as subjects. Photography offered the most practical means of recording. Motion pictures were tried and were quite effective in some laboratories, notably at Yale. But the measuring of the photographs in the successive frames of the motion picture for plotting the results were very tedious.

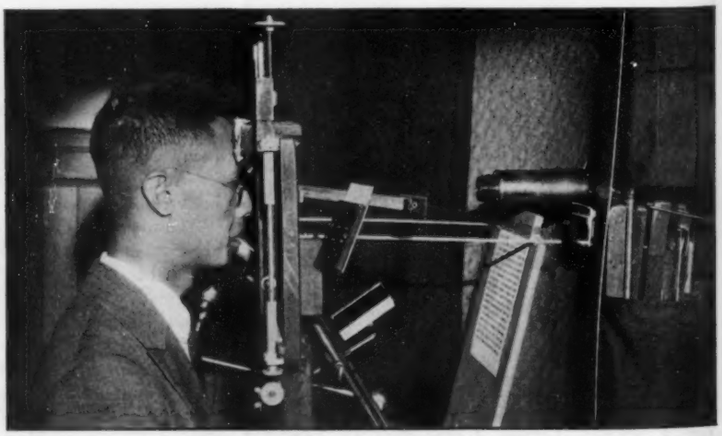
Professor Raymond Dodge, working at Wesleyan University, originated a technique of photographing on a continuously moving film. He illuminated the eye with an arc lamp placed at some distance, and took advantage of the fact that the bright image of the lamp reflected in the eye shifts position with each eye movement, because the cornea has a different curvature from the eyeball and protrudes slightly. This technique is now commonly in use and is the one which we are employing at Stanford University. By this method, the reading of English has been extensively studied, and some European languages also have been carefully examined with interesting results.

Chinese is radically different from those languages that have been studied in this manner. It is arranged in the vertical axis. It is not based upon phonetic spelling. Its characters are all essentially perfect



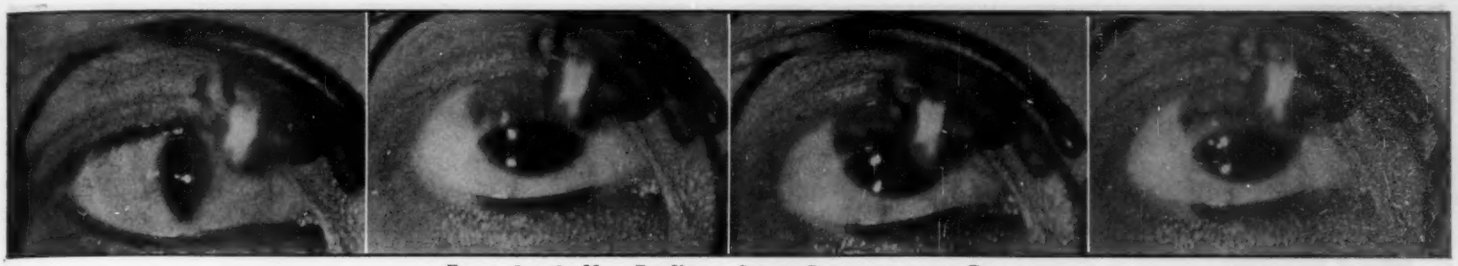
CAMERA FOR RECORDING EYE MOVEMENTS

FIGURE 9: *To the extreme right, in the photograph above, are shown the arc lamp and the motor for interrupting the light and making time measurements possible*



ONE OF THE SUBJECTS UNDER TEST

FIGURE 10: *Notice the two small mirrors that reflect the light to the eye of the subject, and make it unnecessary for him to look directly at the source of illumination*



FIGURES 5 TO 8: MORE EYE VIEWS. SEE THE DESCRIPTION IN THE TEXT

squares so that it may be termed a "two-dimensional" language. Of these the simplest form is a horizontal line, while other characters look like complicated windows of lattice-work and each character may contain more than thirty strokes. It is quite natural to ask whether Chinese is read with the same sort of eye movements as are used for English, whether the eye stops on each character or perhaps even wanders about within complicated characters. The recent investigation by Mr. Eugene Shen and the author is the first study of its kind on Chinese.[1]

The photographs of the eye which accompany this article are for demonstrating just how it is that the bright image of the lamp reflected on the cornea shifts with the movements of the eye and may thus be photographed to give a record of eye movements. These photographs were taken, in each instance, with the film stationary as in an ordinary camera. In Figures 1 and 2, the subject, a Chinese, tried to look steadily at a white pinhead for four seconds while the film was exposed. He succeeded in Figure 1, but in Figure 2 the bright dot on the black corneal area is doubled, showing that his eye moved.

Horizontal eye movements, voluntarily performed, are recorded in Figures 3, 4 and 5. He looked at one pinhead for two seconds and then, with the shutter of the camera still open, shifted his gaze directly to another pin located on the horizontal, 40 degrees distant, and held this position for two seconds. This, at least, is what he was asked to do and what he thought he did. But the white dots on the photographs show that the eye paused at other places. The faint white streaks indicate the paths of movement. Similar tests of 40-degree eye movements made in the vertical are shown in Figures 6, 7 and 8. Here it is likewise seen that the fixations of the pinheads are not perfect and continuous, and also that the path of movement is not actually vertical.

In Figures 3 to 8, inclusive, a spectacle frame carrying a bright metal bead was worn. The reflection from the bead indicates the method of recording possible head movements. Taking Figure 5 as an example, if in place of the stationary film used to take this photograph we had employed a strip of film moving continuously in a vertical direction, each white dot would have registered as a vertical line connected by short, nearly horizontal, lines to other verticals. The whole succession of positions and their relative durations would have been directly plotted and we would have a record of the same nature as Figure 12, but in this case not a reading record.

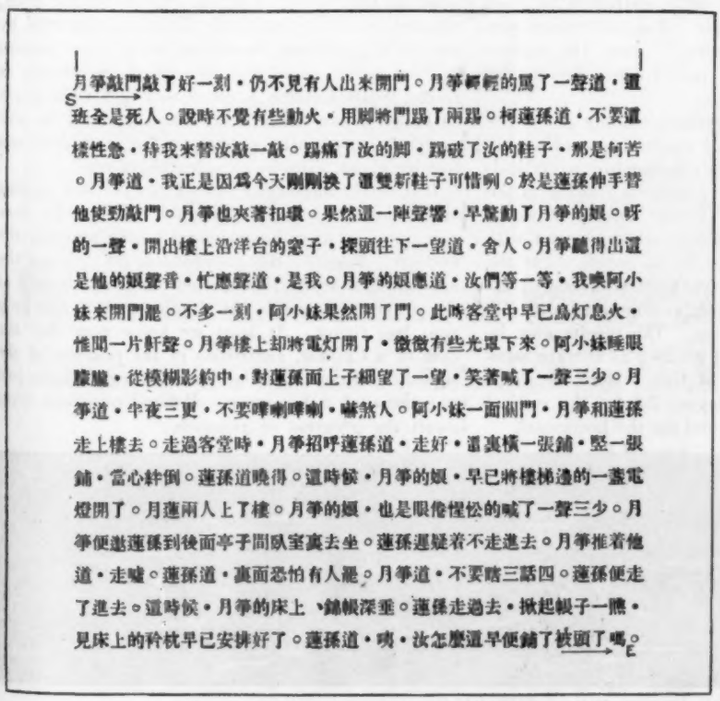
How the Records Were Made

The arrangements of the special photographic equipment are evident from Figures 9 and 10. This is a compact and somewhat modified form of the Dodge type of eye-movement apparatus. The arc lamp and the timing motor, for interrupting the light and thus giving time values to the reading record, are shown at the extreme right in Figure 9. The adjustable head-rest (a support for the forehead and a biting-board) are at the left in the picture. The copyholder is directly in front of this, and just above the copy the lens may be seen extending from the long hood of the enlarging camera. Two small, first-surface mirrors near the subject, (see Figure 10), reflect the light from the arc to his right eye, but from one side so that he need not see the light directly.

The entire eye and adjoining area is, of course, illuminated, but the camera is focused only on the bright light which is reflected from the cornea. Nothing but the movements of this bright spot will record in the subdued blue light that is produced by using filters in front of the arc. The copy is illuminated by a reading lamp with a rather strong yellow light. The film may be moved in the vertical or the horizontal by a spring motor unit mounted at the far end of the hood. The camera provides a five-times magnification. The adjustments are simple and direct and the apparatus may readily serve for recording eye movements under a variety of conditions. A feature that is of particular value is that the page of copy exposed at one time may be quite large.

The specimens of copy to be read, and illustrated in Figure 11, left and right parts, are reduced for reproduction in this article. The squares of text in reality measure six by six inches. Both parts, in this case, contain exactly the same reading material. In the right section it is printed in the vertical as Chinese is traditionally arranged on the page. This would be read by starting at the upper right-hand corner (at *S* on the illustration) and

[1] W. R. Miles and Eugene Shen, Photographic recording of eye movements in the reading of Chinese in vertical and horizontal axes: Method and preliminary results. Journal of Experimental Psychology, 1925, Vol. 8, pp. 344-362.

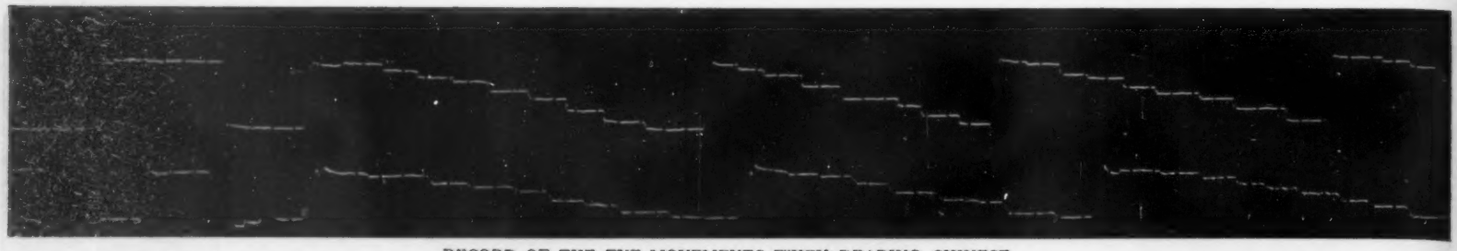


CHINESE WRITING IN ENGLISH STYLE

FIGURE 11, LEFT: *A section of copy, printed in horizontal lines, that was used in making the photographic eye-movement records*

CHINESE WRITING IN CHINESE STYLE

FIGURE 11, RIGHT: *In this piece of copy, the characters are arranged in traditional Chinese form, to be read in vertical lines*



RECORD OF THE EYE MOVEMENTS WHEN READING CHINESE

FIGURE 12: *The lower of the two tracings is a record obtained when the subject was reading vertical Chinese. The upper one shows the results when the subject was made to read Chinese characters arranged horizontally. See Figure 11 for styles*

continuing in the direction of the arrow, reading successive lines from top to bottom until reaching the end at *E*.

In the left section of Figure 11, the same text is printed in the horizontal arrangement that is typical of English, reading from left to right. As the Chinese characters are squares, they may readily be placed in either axial line. At present some Chinese scientific journals are printed in the horizontal. This has the practical advantage of making it more simple to include quotations or names from English and European languages and such things as mathematical formulas.

The illustrative record, Figure 12, of eye movements made in reading, is a combination resulting from reading a page of vertical text and a page of horizontal text. The content of the two pages was, of course, not the same. The camera was turned 90 degrees, between readings, so as to have the film moved at right angles to the direction of reading in each case. The film was thus run through the camera twice. Our ordinary records are made in this manner, photographing two or more reading tests side by side on a film two and a half or three inches wide. The faint white line at the top is from the light reflected by the metal bead on the spectacle frame and indicates that the head was held quite still during the test.

The Time of Eye Movements

The large movements at the beginning of the record, left end, are not reading movements, but are preliminary. The subject looked back and forth at two dots or short black lines placed one at each end of the initial line of copy. A white screen at first covered the copy, but left these dots exposed. The size of the movements made in looking at the dots could be compared with the later movements when looking from the end of one line to the start of the next, as the subject read the copy after the screen had dropped. When the subject gets well launched in the reading, the swift movements made between lines are found to be smaller than the preliminary fixation movements. This indicates that the eye does not actually look to the end of the line nor does it start at the very beginning. The difference in the size of these movements for horizontal and vertical reading (upper and lower tracings in Figure 12) is noteworthy as the length of printed line was in this case the same. This difference is due to a forward shift in the center of rotation of the eyeball when the eye executes vertical movements so that the cornea is not actually displaced as far.

The reading record looks somewhat like a succession of low pitched flights of stairs. Each flight corresponds to the reading of one line. Evidently the record is complete for eight lines of horizontal text and nearly so for eight lines of vertical copy. Proceeding from the left, if we count the "treads" rather than the "risers," we shall find the number of eye pauses to be seven to nine per line, whereas there are 28 characters in a line. The duration of the pauses is quite variable. In the reproduced photograph we cannot count the fine white dots, each representing 1/50 second, which make up the record, except where these have been stretched out due to the swift move of the eye between lines. The little gaps in the lines of white dots are 1/5 of a second apart. From these we can see that the pauses are seldom as short as 1/5 and never, in these tracings, as long as 4/5 of a second. Reading the first line of horizontal characters required 3.6 seconds, and very nearly the same total time value is found for the first line of vertical copy.

Data were collected from the reading of four selections, two vertical and two horizontal, by each of 11 subjects, all Chinese students at Stanford University. In this case each selection was a complete paragraph containing 10 to 12 lines. A full vertical column was 6¾ inches in length with 35 characters, and the horizontal line was 5½ inches long with 23 characters. The characters were of the same size for both alinements. The subjects were instructed to read silently and understandingly. Comprehension was tested by questions in order to make the experiments entirely free from inaccuracies due to the skipping of words.

It was found that the average reading pause for both vertical and horizontal material was about 0.3 seconds, tending to be slightly longer for the vertical. A more consistent difference between reading in the two axes is shown in the average number of words covered by one reading pause, which ranged with the different men from 1.0 to 3.3 words. For the vertical selections, the eleven Chinese averaged 2.3 words per pause of the eye, as compared with 1.9 words in horizontal reading. The results may be stated in terms of speed of reading as average number of words per second of time. Here the range is from 2.9 to 11.0; averaging 7.3 for the vertical and but 6.2 words per second for the horizontal.

A short pause and a long span result in rapid reading, while a long pause and a short span means slow reading rate. The vertical text shows slightly longer duration of reading pauses, but each covers a greater number of words. As a result, the vertical has some advantage in reading speed as found by these highly interesting experiments at Stanford University.

Of course, it cannot be demonstrated that the 11 Chinese used in the test have exactly equal practice in both horizontal and vertical reading. They had all of them read horizontal Chinese since childhood in various books and journals and were well practiced in reading English and, in some cases, other horizontal languages, so they considered themselves well practiced in horizontal reading. In the texts used, the content seemed to be of equal difficulty, the characters were of exactly the same size and type face and the spacing was closely the same. The horizontal lines were shorter in these texts used in our first experiments. However, from the extensive work with English, it is well known that a short line is read with relatively greater speed, hence the horizontal texts in our experiments really had some advantage over the vertical copy. More elaborate and extended experiments by Mr. Shen, as yet unpublished, on strictly comparable texts bear out these first results.

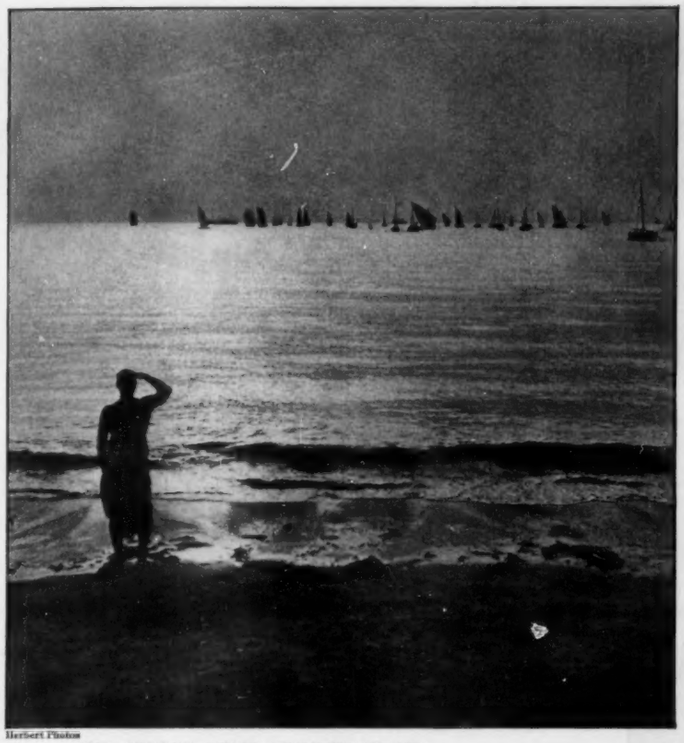
Vertical Reading Less Tiring

Our inquiry has therefore disclosed the fact that the process of reading Chinese is fundamentally the same as for reading English. Each line of print, whether in the vertical or horizontal, is covered by a series of quick movements and much longer pauses. At each pause, more than one character usually is read. While Chinese is condensed and what might be called a two-dimensional language, still the eye moves in essentially a straight line and does not wander about, even in complex characters.

It is surely interesting to find that vertical reading has an advantage over horizontal. We hardly dare speculate on why the ancient Chinese adopted the vertical. Possibly the coordination of moving the eyes along a vertical line, when they are focused at the proper distance, is the simpler and, in the long run, less tiring. At least we know now that the eyes of a Chinese, regardless of the position of the superficial tissue which surrounds them, behave just like those of a European. Related questions must await the progress of research.

CONTINUATION OF THE RECORD AT THE TOP OF THIS PAGE

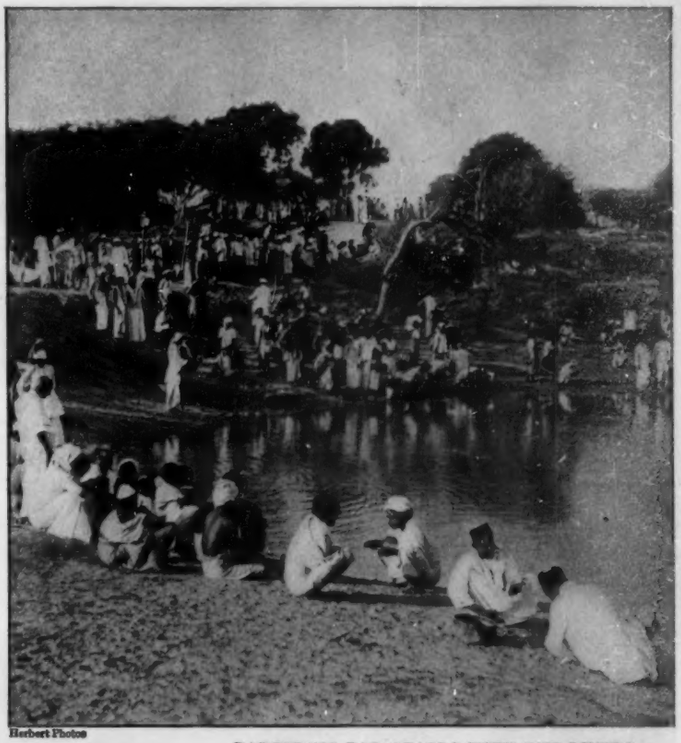
Considering the two tracings as a whole, each set of "stair steps" corresponds to the reading of a single line of 28 characters. Counting the "treads" rather than the "risers" gives the number of reading pauses made by the eye of the subject



Herbert Photos

THE CEYLON PEARL FISHER'S FLEET

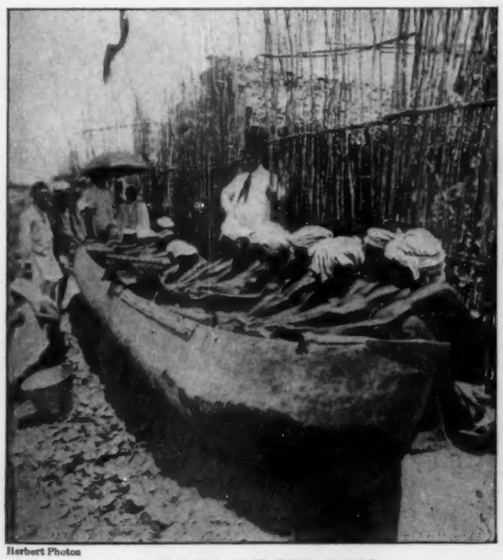
At sunset the picturesque pearl fishers' craft wend their way homeward bearing the day's harvest of pearl oysters. Perhaps there is less than a cupful of pearls in the entire fleet



Herbert Photos

BARTERING FOR PEARLS WITH THE DIVERS

As compensation for their risky work, the divers receive one-third of their finds—provided they are not cheated. These, as a rule, they sell to retail purchasers who line the shore



Herbert Photos

ALL SHOWS BUT THE SMELL

The oysters are piled in a canoe and left to rot in the sun for a week. From the resulting mass of smelly slime the natives knead out the tiny pearls with their hands

Herbert Photos

DRILLING PEARLS IN CEYLON

With his simple bow drill, the driller can pierce forty to fifty pearls a day, thus permitting them to be strung in ropes

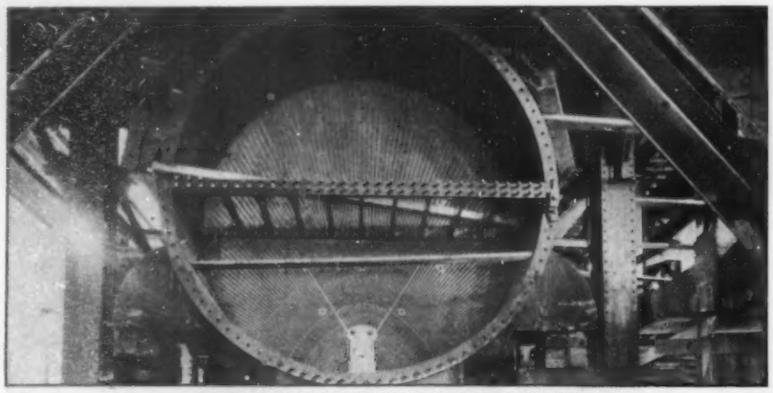
Herbert Photos

RETAILERS HUNTING FOR PEARLS

It is extremely hard to see or feel a pearl in a fresh oyster. Therefore it is the practice to await decomposition before the search begins. The reader may imagine the smell

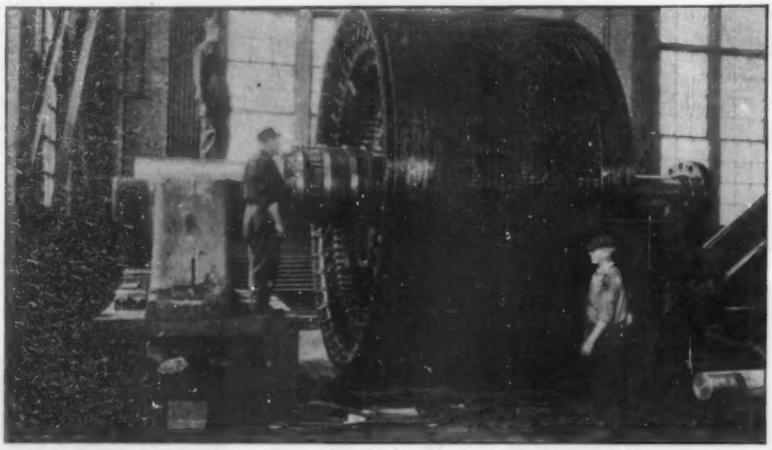
The Romantic Quest of the Iridescent Pearl

Paying a fortune for an optical illusion is what one does when he buys a rope of pearls. The inimitable iridescence of the genuine pearl is due simply to the existence of microscopic corrugations on its surface, spaced about one fifty-thousandth of an inch apart. They produce the colorful optical effect known to the physicist as interference fringes. To demonstrate that the charm of the pearl is only a surface effect let the outer layer of one be peeled off: the pretty gem will become a dull, uninteresting pebble of limestone. What a costly experiment to demonstrate a natural truth! Pearls are found in shallow seas over a large part of the Orient. For thousands of years, among many peoples, they have possessed a religious significance, while there are many who believe it was the romantic world-wide quest for pearls which led to the diffusion of early civilization from some near-Mediterranean center to the east, and ultimately across the broad Pacific. Pearls abound near the isles of that misnamed ocean and their quest provides a large part of the living of the islanders. Many a true romance has been written around the adventurous lives of pearl dealers in the Persian Gulf, India, Ceylon, the Spice Islands, and Australia. But these are not the men who find the pearls. The native, accustomed to the water from boyhood, becomes almost a human fish. As a diver, he generally remains under water from fifty to eighty seconds.



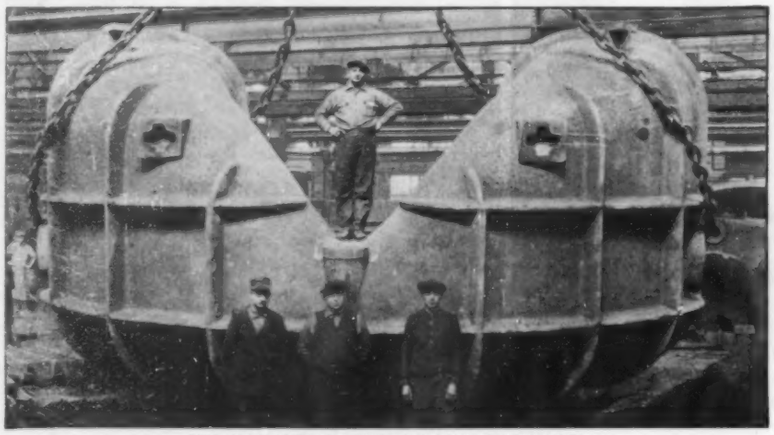
100,000 GALLONS OF WATER PER MINUTE

Nearly 100,000 gallons of water coming to the condenser through six-foot, cast-iron pipes will flow through the condenser each minute. More than 40 miles of brass pipe, with a total surface of over one acre, will condense the exhaust steam from one of the 60,000-kilowatt turbines



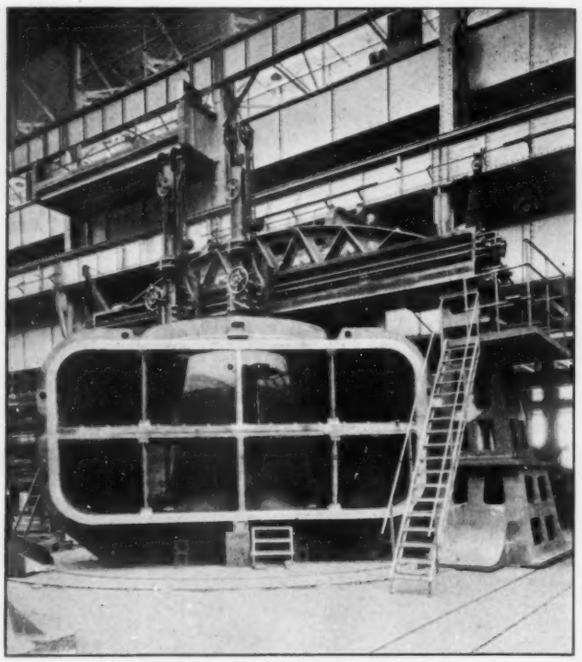
ROTOR OF A 40,000-KILOWATT FREQUENCY CHANGER

This big wheel, 13 feet in diameter, is part of a machine which will be used to interchange current at different frequencies between the generators of the East River Station and the Hell Gate Station. These stations are miles apart, but the voltage and cycles are different



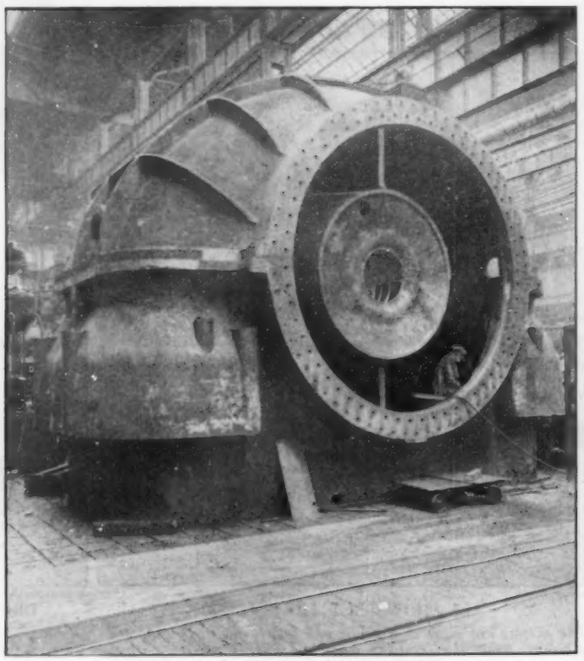
UPPER HALF OF TURBINE EXHAUST HOOD

The huge iron casting shown above is part of the 60,000-kilowatt turbines. It is the largest casting ever made at the General Electric Plant at Schenectady, New York



BORING OUT THE EXHAUST HOOD

Boring out an enormous casting for the lower half of one of the turbine exhaust hoods for the new million-horsepower generating station. Although a comparatively small volume of high-pressure steam enters the turbine, its expansion is so great that a huge exhaust hood is necessary to carry low-pressure steam to the condenser

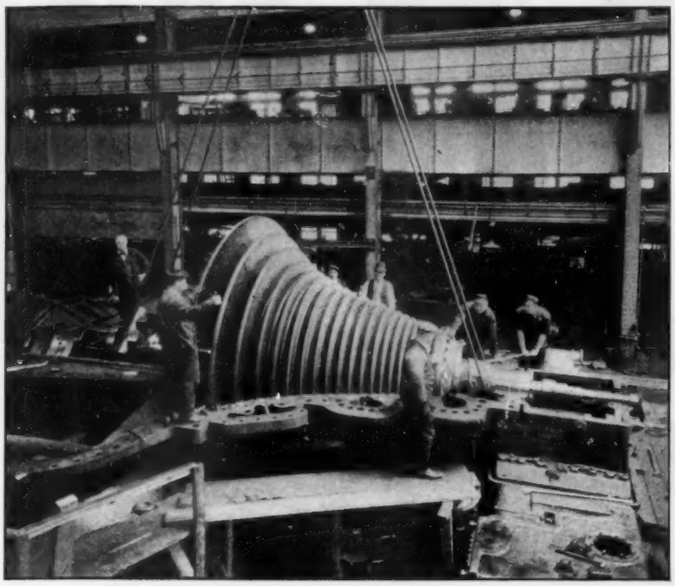


THE ASSEMBLED EXHAUST HOOD

This photograph shows the assembled turbine exhaust hood. The condenser is constructed directly below so that exhaust steam passes directly to it

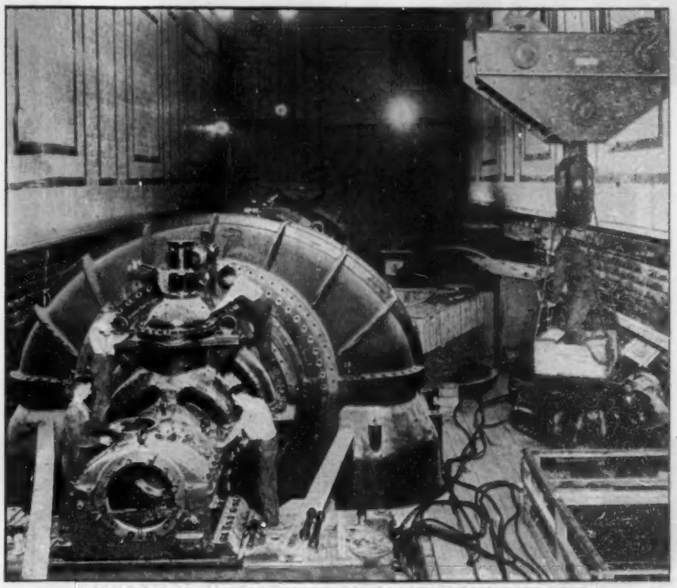
A Power Plant Greater Than Niagara or Muscle Shoals

Sixteen million persons will live in the New York metropolitan area by 1950, according to the estimate of experts. At present, with a population of about 6,000,000 or approximately five percent of the total population of the country, New York City requires close to 10 percent of all the electrical energy generated in the United States. It is not surprising then that the New York Edison Company is now building in Manhattan, the world's largest electric generating station. The station is located at the foot of Fourteenth Street where the river close by will furnish the tremendous quantities of water required by the station for steam condensing purposes. The water will flow from the river to the condensers through six-foot, cast-iron pipes buried in the concrete foundations and its volume, more than 800,000 gallons each minute, will be greater than the amount used by New York City for all other purposes combined. It is expected that the station when completed, will have a capacity of approximately one million horsepower. This is sufficient to light more than three million six-room homes. The force of the turbines which will develop it is greater than



THE WHEEL WHICH WILL DRIVE THE GENERATOR

This rotor contains 20 sets of blades. They vary in length from four inches on the smallest wheel where the high-pressure steam will enter to 40 inches on the largest wheel. The outer rim of the largest wheel will travel at 12 miles per minute

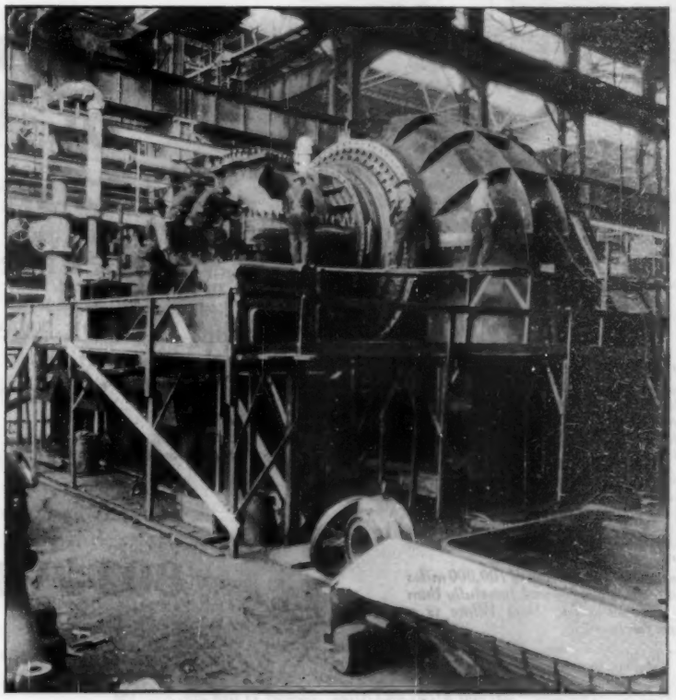


PHOTOGRAPHING MOST POWERFUL MACHINE ON EARTH

To make it possible to photograph from every angle the most powerful single-unit machine on earth, one of the 60,000-kilowatt turbines at the East River Station, it became necessary to use a 200-ton crane to lift the 150-pound photographer

A CORK FLOOR IN A COAL MILL

To prevent vibration from the coal crushers, which will prepare the coal for the station's boilers, from being transmitted to the building in which they are contained, the concrete foundations of these crushers will be lined with cork. Above is one of the cork layers

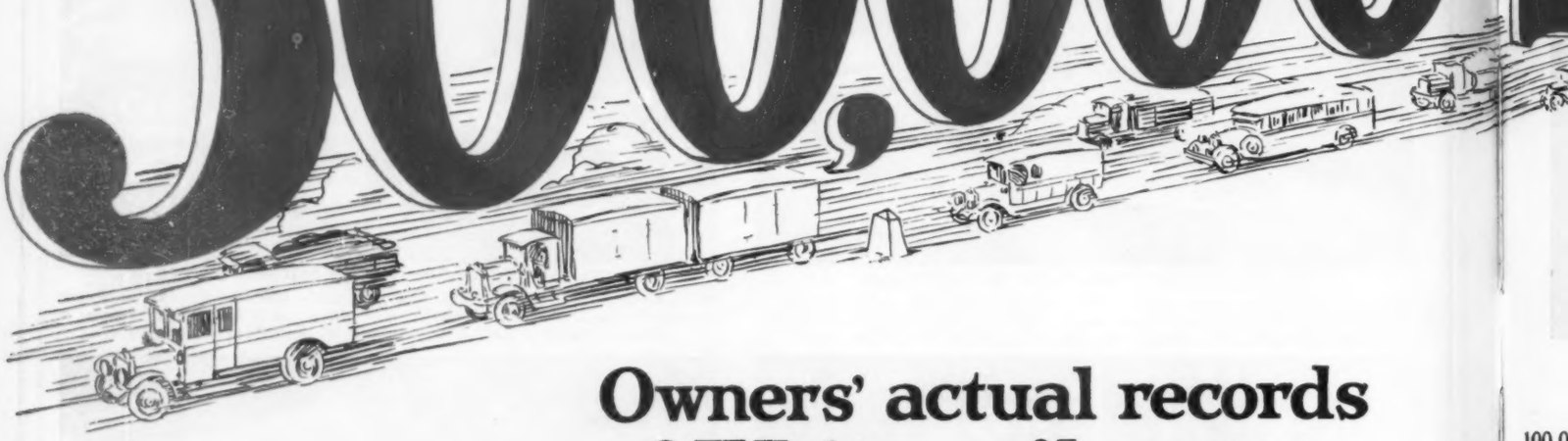


ASSEMBLING THE TURBINE FOR TEST

The photograph above shows one of the turbines being assembled at the plant of the General Electric Company in Schenectady. This is the largest single-unit turbine ever built and is capable of power greater than that of 80,000 horses pulling together

that which could be exerted by 1,000,000 horses pulling together. The equipment of this station, parts of which are illustrated in the accompanying photographs, represents the most advanced practices in central station design, yet it is at the same time sufficiently conservative to insure the reliability necessary for the absolute continuity of service which the New York Edison Company has maintained since its organization by Thomas A. Edison in 1882. In the first unit of the station which is now approaching completion, there are two 60,000-kilowatt turbine generators. These turbine generators are the largest single-unit machines which have ever been built. One of them would have been sufficient to supply all the electrical needs of the city twenty years ago. They will generate current at 11,400 volts and 25 cycles. This will be sent to the company's numerous sub-stations throughout the city where it will be converted to 120-volt direct current. Five huge boilers will be used to supply the great quantity of steam for each turbine. One of the unique features of these boilers is that all four walls are lined with steel tubes which carry the water which is to be changed to steam. In ordinary boilers the water is heated only in the rows of tubes at the top of the furnaces. In this boiler by the addition of the water tube walls the heat which ordinarily would be wasted in the brick walls of the boiler, is made use of. The 4,000 tons of coal which will be burned in the boilers of the completed station every day, will be brought to the millhouse by barges where it will be shot into the boilers through nozzles where it will burn in flames 40 feet long, as though it were oil instead of coal. The heat of the waste gases coming out of the huge boilers will not be entirely lost for it will be used to preheat the air which is needed for the combustion of coal under the immense boilers.

300,000



Owners' actual records of White mileages~

72 Whites have run **500,000** miles and more each

384 have run between **300,000** and **500,000** miles each

951 have run between **200,000** and **300,000** miles each

1658 have run between **150,000** and **200,000** miles each

4959 have run between **100,000** and **150,000** miles each

giving the astounding total~

8024 Whites have run **100,000** miles and more each

300,000 miles is 12 times around the earth at the equator.
. . . It is more than the total miles of railroads in the United States.
. . . It is 100 times the distance from New York to San Francisco.

Nowhere does the meaning of 100,000 miles stand out more clearly and forcefully than on the balance sheet. Here White is a synonym for profit.

Our new "300,000 Miles and More" booklet is just out, with the names of all the owners and the number of Whites each owns in each mileage classification. You will find leaders in all industries, firms in your own line of business, your neighbors, your business associates. We will gladly send the booklet free. Write for it.

Before you buy a truck or a bus see the Whites at any of our 75 factory branches or 500 dealers. There is a White model to meet every transportation need.

	Truck Chassis	
Model 15	— ¾-Ton	$2,150
Model 20	— 2-Ton	2,950
Model 51	— 2½-Ton	3,750
Model 40A	— 3½-Ton	4,350
Model 52	— Heavy Duty	5,100
	(Several types of power dumping bodies and hoists available)	
	Bus Chassis	
Model 53	16 to 21 passengers	$4,250
Model 50-B	25 to 29 passengers	5,350
	(All prices f. o. b. Cleveland)	

WHITE

and WHITE

200,000 100,000 miles and more

No owner will operate a truck or bus long enough to run 100,000 miles . . . unless those miles are money-earning miles

100,000 miles—White miles—mean more than an exceptionally long distance; more than an exceedingly durable, well-built, well-serviced motor truck or bus.

They mean unusual profits. They mean net earnings—in excess of all costs. They mean continued earnings long after the original cost has been written off the books.

200,000 miles mean all that—doubled. 300,000 miles mean all that—trebled. So on . . . . Picture the earnings of the scores of Whites that have exceeded 500,000 miles. Then picture what these mileages would mean in your own business, knowing your average mileages for a week or a month or a year.

White 100,000-mile records are not isolated performances, not special achievements under especially favorable conditions. Whites, by the thousand, exceed 100,000 miles with a regularity that makes it standard performance. . . . . All models do it. They do it in all lines of business. They do it everywhere, under all conditions of load, road, weather and climate. They do it in fleets and in single installations.

More than 8,000 Whites have run 100,000 miles and more. More than 1,400 have run 200,000 miles or more. More than 400 have exceeded 300,000 miles. The original cost of most of these 8,024 Whites has been written off the owners' books. . . . . And these mileages are actual owners' figures. They do not include many hundreds of additional Whites that have passed 100,000 miles, but whose owners have not sent us accurate records. Neither do they mirror the splendid earning records of thousands of Whites that have been serving dependably for ten, twelve, fourteen years, carrying their pay loads, without reaching the 100,000-mile mark.

This record, published annually, stands alone. No other truck manufacturer has ever published such a volume of evidence of dependability, long life and continuous earning power. No other truck manufacturer can.

THE WHITE COMPANY
CLEVELAND

In light delivery service 100,000 miles means millions of packages delivered at lowest cost. Whites build business and swell profits.

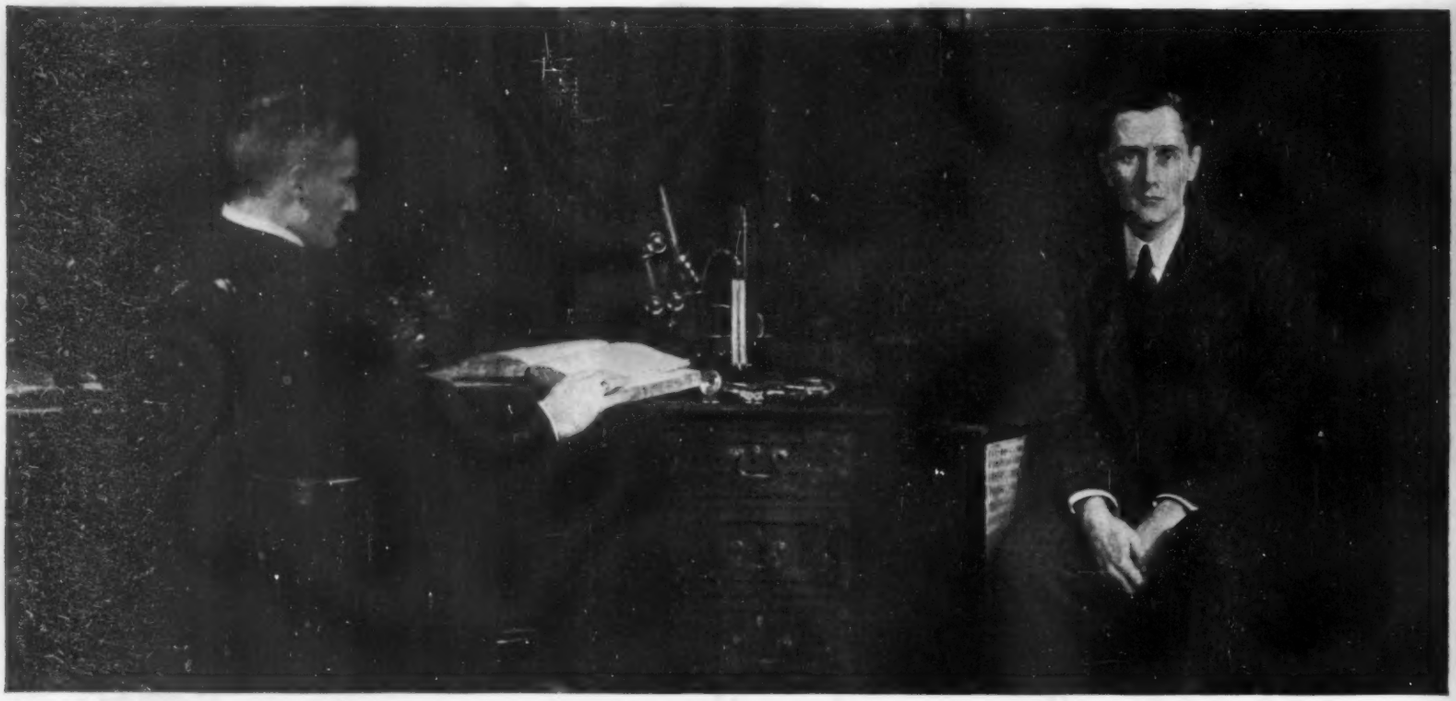
Some White Busses have run more than 500,000 miles. More than 200,000 miles for a White Bus is usual performance. And they are all money-earning miles.

Translate 100,000 miles into the terms of any sort of hauling—tons, yards, packages, cases or gallons—and the meaning is always money earned.

In service where loads are heavy and hauls are short it may take many years for a truck to run 100,000 miles. Hundreds of White Dump Trucks have passed this mark and are still earning.

TRUCKS
BUSSES

© THE WHITE CO., 1926



"THE SENTENCE OF DEATH," BY THE ENGLISH ARTIST, HON. JOHN COLLIER, TELLS ITS OWN SAD STORY

How Death Deals Its Cards

Death in a Thousand Shapes Is Knocking Eternally at Everyman's Door

By Albert A. Hopkins

IF one were to take down one of the catalogue drawers, "De" to, say, "Dg," in a large public library, he would be astonished at the number of entries under "Death." A vast literature has grown up around this subject which is treated from every angle. The historian, the philosopher, the artist, and poet, the physician and the theologian have all added their quota to the sum of our exact knowledge, or to more abstract speculation on one of the great mysteries of human existence. Great scientists have labored to clarify the conflicting opinions and far-flung theories. Investigations along psychic lines have not been convincing enough for us to follow the remarkable tales of the French astronomer, Flammarion, in his volumes on death. Death seems to be the finality as far as this world is concerned.

We might well ask, "What is death?" A definition is difficult, but the following might answer: Death may be regarded as the departure of the principle of life from the body, which brings to an end man's physical relations with other men who are still on earth and with the world of sense as a whole. In this sentence, nothing is necessarily implied as to the relation of the dead with one another and with God in a further state of existence, nor indeed of the continuance or disruption of spiritual relations with the living.

Death is as necessary as birth for the continuance and progress of the human race and life cannot even be imagined without death. A man's ideas on death depend largely on the particular conditions of his own life and his surroundings, while his ideas and ideals of life may be considerably modified by his views and hopes regarding the nature of death and the nature of the human soul. La Rochefoucauld—a wise old philosopher—has said that man could no more look steadily at death than at the sun. A life of active duty is the best preparation for the end, and so large a part of the evil of death lies in its anticipation that an attempt to deprive it of its terrors by constant meditation, almost necessarily defeats its object and annihilates the ambition and enthusiasm that are essential to human progress.

We could fill pages with beautiful legends, and curious happenings, but it will prove more valuable to confine ourselves to facts as they occur in the publications of the Bureau of the Census so admirably compiled by Dr. W. H. Davis in the annual portly volume called "Mortality." Our graphical comparisons give the salient figures. First we would like to know how the United States compares with other countries. Examine the "graphs" of general death rates where we find that we are about as long lived as the inhabitants of England and Sweden, but we fall far below the low death rates of Australia and New Zealand. If you want to live long, do not sojourn permanently in Chile or Spain. France, Germany and Italy also are not safe abiding places for potential Methuselahs.

To Live Long, Live Slowly

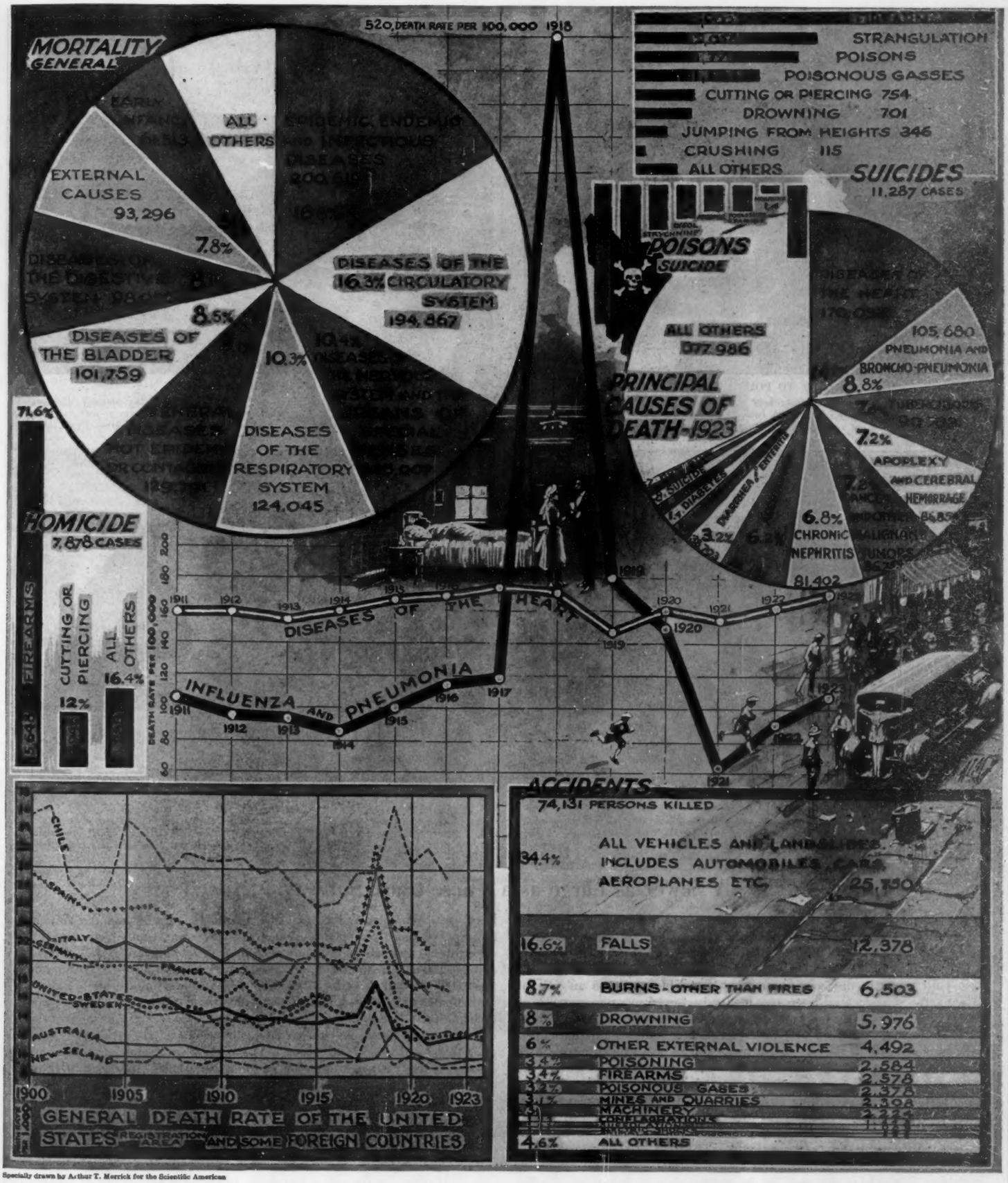
The "pie chart" showing general mortality indicates the great classifications of groups of diseases attacking the bodily system while the other circle gives specific diseases or causes of death. Modern medicine and modern sanitation has profoundly modified some of these figures, but there is still a chance for radical improvements which must largely come from attention to personal hygiene. We drive too hard in this country as our graph indicates.

Accidents totalled 74,131 victims in 1923. Here let us explain that figures of vital statistics are so slow in coming through, and require so much checking that they can never be strictly up-to-date. Inaccurate or hastily prepared figures would be most misleading. Of course, we know what "all vehicles" really means. "Landslides" are technically classed with automobiles, cars, et cetera. The airplane is not a very great risk, as the number of passengers carried is small and the deaths in service flying are not numerous. Falls produced 12,378 deaths; many of these fatal accidents were preventable.

Suicide and homicide figures have received great attention from statisticians. It is interesting to note the methods of self-destruction used by persons who wish to "end it all." One would naturally expect fire-arms to top the list, but would hardly think that strangulation (meaning hanging in most cases) would be a close second. Jumping from heights is a particularly vicious method of suicide as in many cases it results in death or injury to the innocent passer-by. The government statisticians have even analyzed the poison of the suicide, and carbolic acid which makes such a painful passing out seems to be the most sought for poison.

Homicide cases appear to fall in two classes; firearms, stabbing and slashing. So long as we have such poor laws relating to pistols that the gunman can stock up his arsenal at will—while the house-owner can only obtain permits after endless fingerprinting, photographing and red tape plus a substantial fee—we must expect such heavy mortality. It would be interesting to know whether the law ever took toll for many of the 7,878 cases.

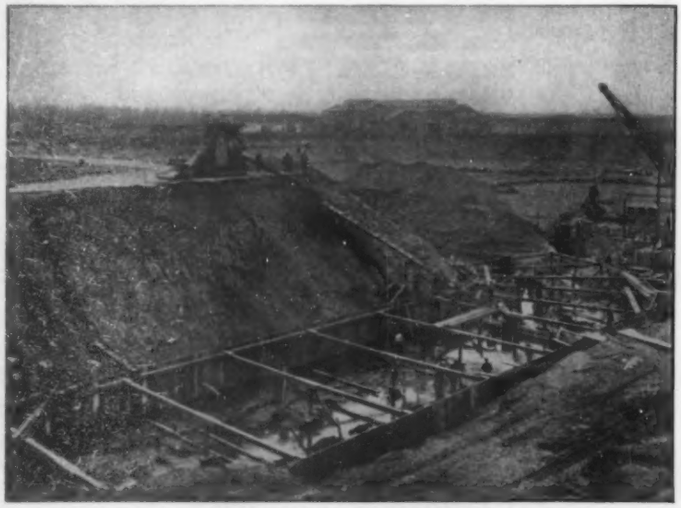
The lessons to be derived from a contemplation of figures of mortality are many. Take life easier, avoid straining the heart, watch your step and other peoples' automobiles, do not neglect a cold and cultivate calmness of mind. This is all we can do, but wait—"The old, old, fashion! The fashion that came in with our first garments and will last unchanged until our race has run its course, and the wide firmament is rolled up like a scroll. The old, old fashion—Death."



Specially drawn by Arthur T. Merrick for the Scientific American

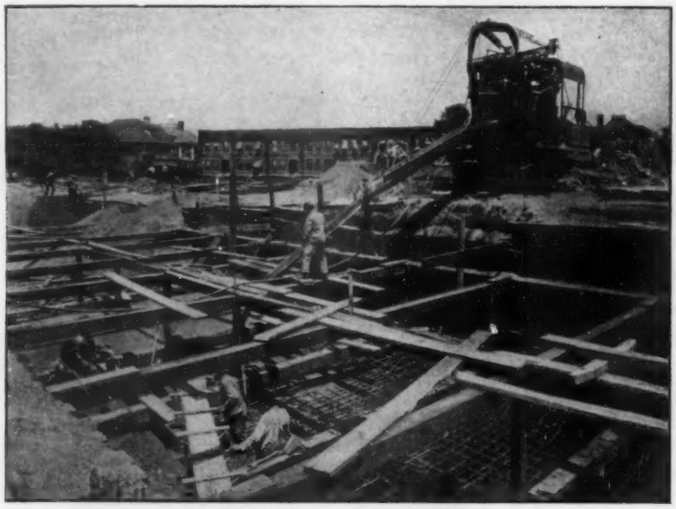
Of What Will You Die? Graphical Comparisons Relating to Mortality

The various causes of death are displayed in graphical form and show what may be the ultimate cause of anyone's death. In the year 1923, the number of deaths in the registration area of Continental United States was 1,193,017. The registration area includes 87.6 percent of the total population of the United States. Some states are not now admitted to the registration area by reason of their unsatisfactory methods of recording death.



READY TO POUR CONCRETE

Retaining walls of heavy sheet piling kept the spoil-banks at the sides from sliding into the open cut. On top of the high bank is a concrete mixer: ready to pour the floors of the great sewer, while a battery of pumps keeps the water out

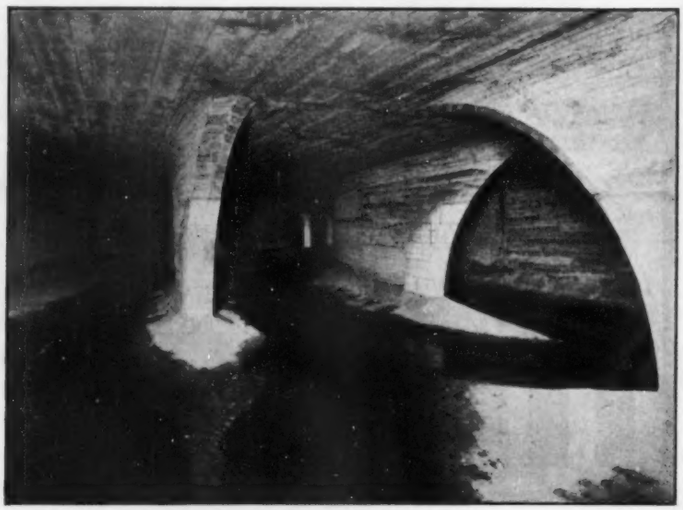


POURING THE CONCRETE ROOF

The floor and walls have been completed and now the roof is being poured. Baskets made of steel reinforcing rods will add their strength to it. A stream of wet concrete issues from a mixer situated on the bank beside the job. Work progresses rapidly

LINING THE CONCRETE SHELL

When the concrete floor, walls and roof had set, the whole was lined with plastic concrete. This work was facilitated by the movable steel framework shown in the illustration. This supported the lining until it had set enough to stay in place



FINISHED AND CARRYING WATER!

This picture was taken at a bend in the triple-barreled sewer. Each barrel is amply large to serve as a highway. The whole job was called a "sewer" but it really amounted to putting a river underground. Even as a storm sewer it is unusually large

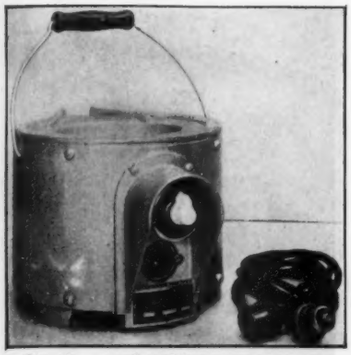
A Sewer as Large as a Three-track Subway

What is said to be the largest sewer in the world, resembling nothing so much as an overgrown three-track subway, yet which is not intended to carry any sewage at all is just being completed in Brooklyn, New York, at a cost of about $3,500,000, according to Frank W. Skinner, C.E. It was built solely to discharge the storm water which falls on an area of 3,500 acres of residential districts. It may be forced to carry as much as 67,000,000 gallons per hour. Most of the time this great sewer, about three miles long, will be nearly dry. The largest portion, near the outlet, will have a width of 47 feet and a height of 13 feet, consisting of three rectangular tunnels, each amply large for a railroad train, separated by partition walls. The magnitude of this piece of engineering work is indicated by the vast quantities of material involved, the 10,000 large truck loads of earth and sand which was excavated being sufficient to fill a 100 by 100 foot pit a quarter of a mile deep; the 2,700,000 cubic feet of concrete having a volume as great as that of thirteen twenty-family apartment houses; the more than 6,000 tons of steel used to strengthen the concrete weighing as much as that used in the construction of a good-sized office building and the 3,000,000 bricks with which the floor of the sewer is paved being enough to lay eight miles of roadway 16 feet wide. The most interesting features of this great piece of municipal construction was the unusual methods employed, the rapidity, efficiency and economy with which it has been completed and the fact that it was done in a few months without accident, or much public inconvenience. The work required an army of nearly 1,000 men, and a mechanical equipment of powerful steam, electric and pneumatic machinery of the latest type, which, although it cost more than 200,000 dollars, also saved hundreds of thousands of days' labor. Perhaps the most important elements of this piece of construction were the execution of all the work in an open trench nearly 40 feet in greatest depth, the fact that it was excavated in the center of the street, and that after the completion of the sewer it was refilled with sand and earth and repaved without damage to costly buildings adjacent to it, and with little obstruction to important traffic. This eliminated the slow, dangerous and costly methods involved in the operations of tunneling through treacherous sand, but on the other hand it involved the excavation and rehandling of millions of cubic feet of sand overlying the roof of such a tunnel. Operations were commenced simultaneously at half a dozen approximately equidistant points, at each of which the earth and sand were excavated at the rate of 15,000 to 20,000 cubic feet daily, by steam shovels, scraper buckets and by clamshell buckets. As the excavation proceeded the loose, treacherous sand in the vertical sides of the trench was kept in place by a continuous wall of thick, vertical planks driven by a large battery of powerful hammers operated by compressed air.

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins



Simple metal-melting arrangement

Portable Electric Melting Pot

IT has always been troublesome to melt small quantities of metal, such as babbitt, type metal, solder, lead, tin, et cetera, by ordinary methods. Now it is rendered easy by an electric melting pot wherein the current is controlled by a three-heat switch. This device is adapted for ladle and dip work, as well as for pouring.

A Two-way Automobile

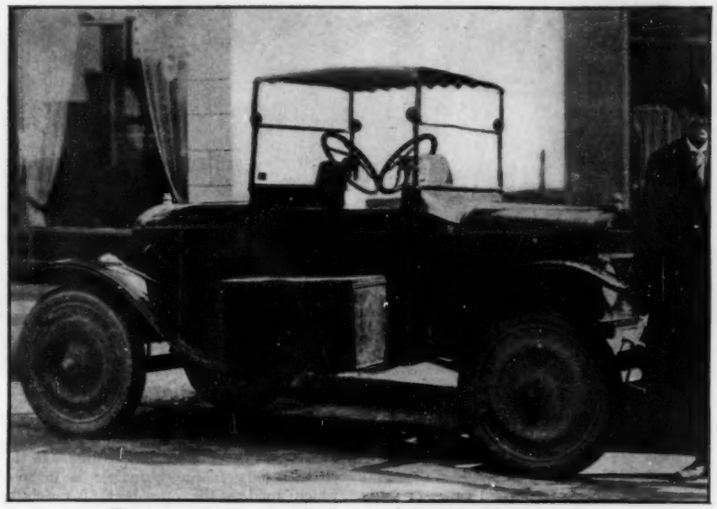
"IS this machine coming or going?" one may ask. As a matter of fact, it can go either way since it has double gear controls, and double steering mechanism. One advantage of this machine is that it can be parked on either side of the street, regardless of the direction in which it entered. The car is owned by Mr. W. D. Henderson of Memphis, Tenn.

A Spring-driven Electric Lantern

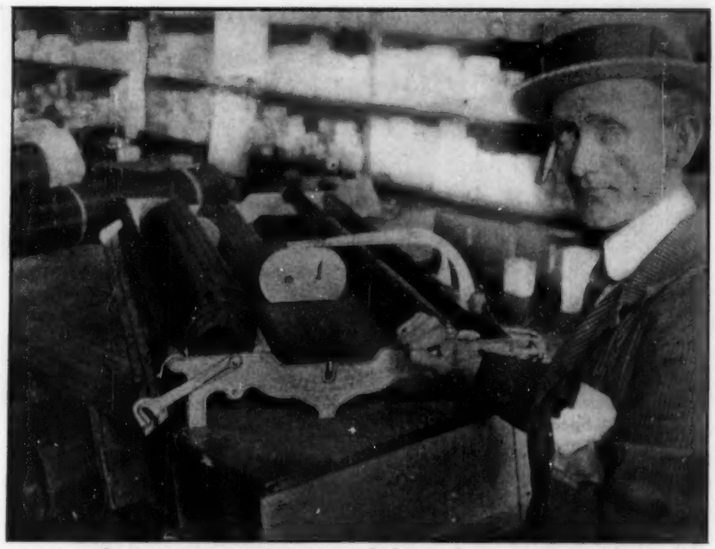
THE electric lantern we illustrate is not a toy but is a sturdy, dependable light for use in camps, boats, factories or the home. It creates its own current by means of a generator driven by a strong spring. When fully wound up, it will give light for three minutes.

Screen Measurer and Cutter

A MACHINE is now in use which assists in making sales of wire screening. A roll is slipped on one of two rods, and the free end of the netting brought through between two flat steel bars. The end of the wire is slipped over small burrs on the second rod, which has a crank handle attached to one end. A movable arm, with two small dials, is placed on the netting, and indicates the amount unrolled. A blunt knife blade is drawn along the slot between the bars, when the proper amount is measured off, and cuts the netting square. The crank is then given a slight reverse turn which frees the burrs and allows the netting to be slipped off the crank-rod.



This unusual automobile has complete double equipment

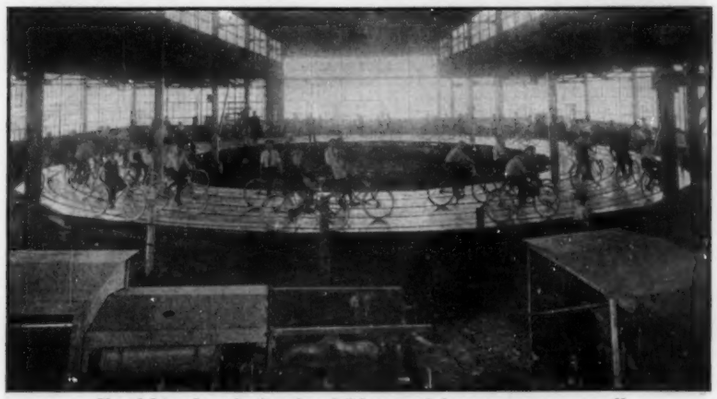


Cutting wire screening accurately by machine saves material

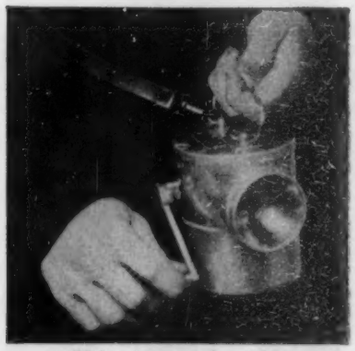
Relief for the Scrubber

WE show in these columns, a rubber mat, of English origin, intended to ease the labors of housemaids or other people who have to do scrubbing. It consists of a rubber pad made in two curved, connected sections to fit both knees. A device of this kind would seem to have other uses; for example, it would aid mosaic tile layers.

Protecting the housemaid's knees



Novel bicycle ride for the children and for grown-ups as well



Makes its own electricity

An Indoor Bicycle Ride

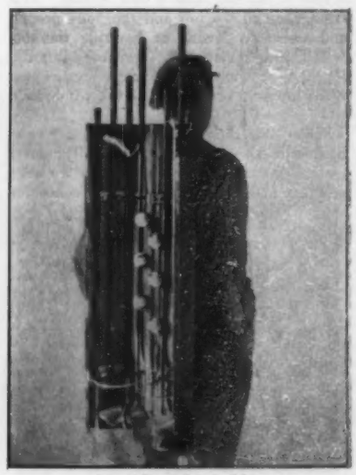
IN the amusement device shown on this page, several bicycles are mounted on a series of concentric rings. These are rotated by a motor and as the bicycles travel in a circle, the passengers can rotate the pedals to their hearts content, thus deriving beneficial exercise and a great deal of fun.

Number of Motor Vehicles in Use

ACCORDING to a report recently issued by the British Ministry of Transport, the number of motor vehicles in Great Britain is now nearly 1,400,000, says *Machinery*. Of these motor vehicles, 533,000 are privately-owned passenger cars, 518,000 are motorcycles, and about 230,000 are trucks, the remainder being taxicabs. There is approximately one motor vehicle in England to every thirty inhabitants, if motorcycles are included. In Germany, there is one automobile for every 272 inhabitants; in France, one for every 69; in Japan, one for every 2,700; in Russia, one for every 9,000 and in China, one for every 40,000.

An Unusual Golf Bag

THE golf bag shown below opens in the center. Each club is held by a metal frame, which supports the bag as well. If the bag is turned upside down, not a club will fall out. The balls are also held by metal clips attached to the frame. The bag locks automatically when closed.



An aid to the golfer

Spats for rainy days

A Convertible Automobile Body

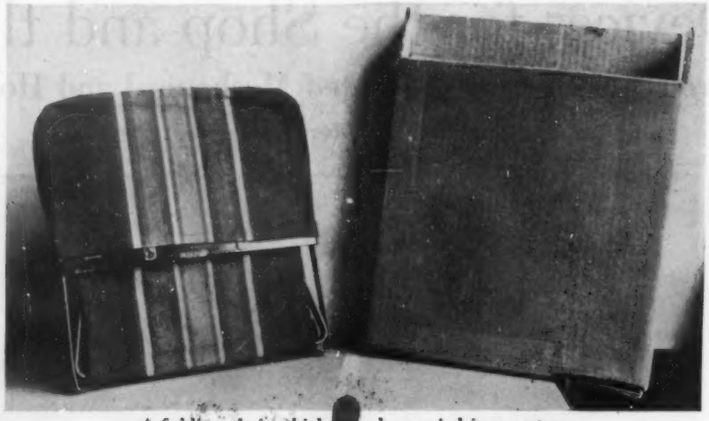
AN automobile body, which can be converted from a closed job of standard appearance and rigid top, to an open car with a top entirely concealed has been found practicable. The rear end of the body is provided with a cover plate, which, when it is desired to lower the top, is swung back out of the way. The fastening mechanism is then released from the wind-shield frame and the top is ready to be swung. This top is hinged to the body and

Model showing top concealed

a tensioning device is provided, which includes a cylinder and a coil spring. This is attached to the top and the body proper, and assists in raising or lowering the top. It also prevents the top from forcibly striking the bottom of the rear compartment when lowered, or the top of the wind-shield when raised.

When the top is lowered, it is swung back into the rear compartment. The cover plate is then in turn swung back to a closed position, and the top is completely concealed

An improvement in ice bags

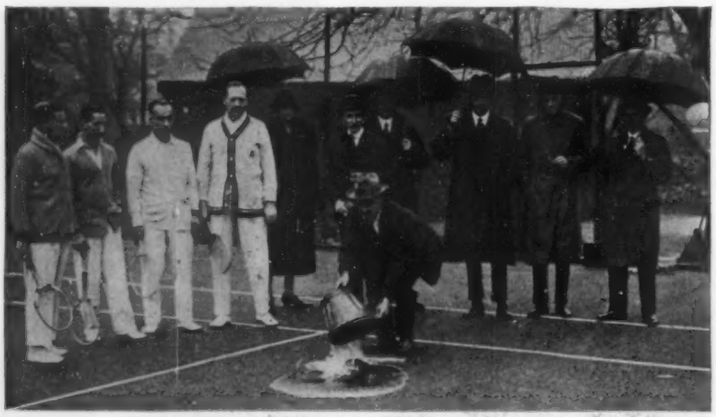


A folding chair which may be carried in a carton

from view. With the aid of the tensioning device, the raising and lowering can be easily accomplished by one person in a short time. The glass panels are housed in the door when the top is lowered.

A New Style for "Flappers"

STORES and shops are being besieged now for the "last word in flapper vogues." This is in the form of "Sandy Rain Spats"—a newly devised gaiter or spat to be worn over the stocking to protect them



Special cement makes tennis possible in rainy weather

from mud and rain. This invention fits snugly over the foot, and is made of rubber.

Circular Ice Bag

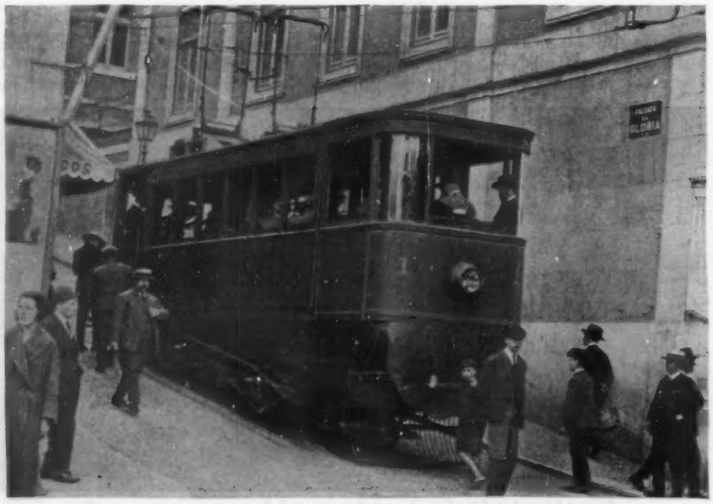
AN improved throat ice bag is made circular in form and has a concealed spring which holds the bag snugly in position. The screw cap is in front, out of the way. All ice bags used for sore throats have been made heretofore in some form other than circular which is, however, the logical shape.

A Comfortable Folding Chair

MOST folding chairs, after one has a tussle with them, yield in time but are as uncomfortable as is possible. In this chair, a new folding principle is involved which renders the operation of unfolding easy. The sturdy construction makes the chair stable, thus adding to the comfort. The chair folds in such compass that it can be carried in a small paper carton.

Any-weather Tennis

DESPITE the very bad weather, tennis was played in the open in London recently, when a demonstration game was



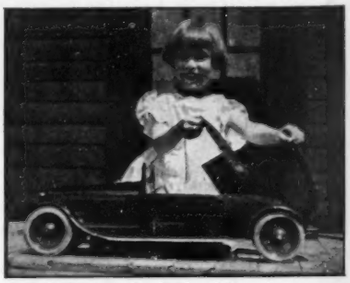
A car built like the cars of mountain railways

The chair when unfolded

given on a new type of hard court. The cement composition soaks up water almost immediately, leaving the court quite dry for playing even while it is raining. The nature of the cement composition was not divulged.

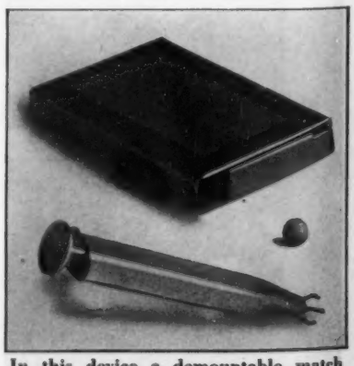
Trolley Cars for Hilly Cities

LISBON, Portugal, like Rome is built on hills—there may be seven or even more—we cannot say. The trolley cars used in Lisbon are built like the mountain railway cars in Switzerland so that the passengers' seats have some claim to the horizontal. This is accomplished by having one pair of trucks directly under the car, while the other is placed at some distance from the

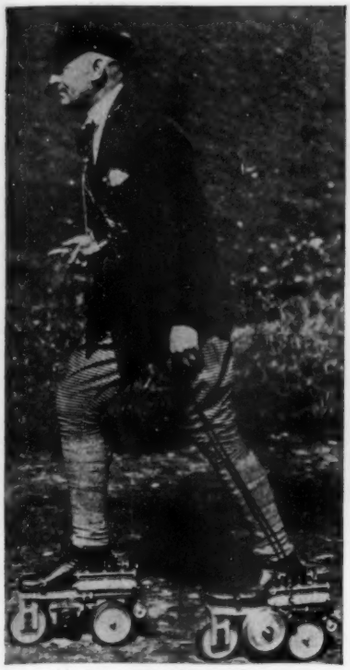


Swinging back the hinged top

floor-frame. Thus the car really rests on a wedge. To all appearances, the trolley is trackless. It is probable that similar cars could be used in San Francisco where the hills are numerous.



In this device a demountable match head is held by the prongs and lights on the box. The match burns a long time, even in the wind



Modern seven league boots

Power Roller Skates

AN automotive engineer of Munich, Germany, has designed motor skates which are very ingenious. A motor is applied to each foot and there is even a little fly-wheel, fuel tank, gage, et cetera. It is said that considerable speed may be attained with these power roller skates.

An Open-air Crib

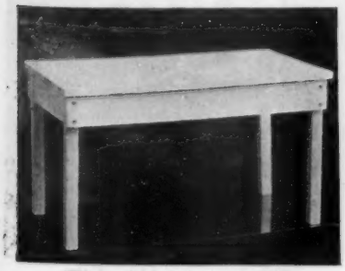
ALMOST anybody can build this open-air crib. It is, of course, very essential to have the floor supported as shown so there will be no danger of the baby falling. Wire netting should be provided all around, including the top, so there will be no chance for the baby to fall out. A wire door could be constructed to give access to the crib, or the window itself could be shut down so that the child would not fall into the room.

A Universal Clothes Rack

WITH small rooms, every inch of space counts, so that the rack shown is most convenient. Facilities are provided for hanging suits, underclothing and ties, and devices have even been provided for taking care of shoes. We do not know what idea the maker had in mind when painting it white, but it is a good one since the rack can be distinguished in poor light.

A Novel Bank Check

A NUMBER of banks are using the form of check shown in the illustration which does not differ materially from that which has been in use for a long time on money orders. The idea is, of course, to protect the customer against the raising of a check. On the margin, there are printed amounts on the left end of the check so that the amount of the check may be cut into the margin and any attempt to alter the face value will be disclosed immediately.



When the table is a table

Giving the apartment-house baby light and air without danger

A Latitudinally Bound Tire

THE present automobile tire is bound by cords both longitudinally and latitudinally in order to give sufficient body to the tire. The newly patented tire is bound latitudinally—from rim edge to rim edge—but is not bound longitudinally. That is, while cords run crossways in the tire, no cords run in the circumference of the tire. As a result, the tire may expand and contract like a rubber band in the direction the wheel travels, but cannot change its other dimension. This condition gives a remarkable resilience to the new tire. Perhaps the most astonishing feature of the invention lies in the manner in which the new tire is fastened to the metal rim. All lugs, all bolts, the collapsible rim, and the shoulder are done away with. At the edges of the new rim, the metal thickens to give a perfectly smooth top surface an inch wide with a twelve and one-half degree taper whose highest point is on the outer side. Correspondingly the tire has its edges formed in a nonelastic bead with an opposite taper to that on the rim. The inner tube is put on the metal rim of the wheel unit, the new tire slipped into place with no more than hand assistance, and the inner tube is inflated.

New York June 27th 1925 No. 100
THE COAL & IRON NATIONAL BANK
OF THE CITY OF NEW YORK
PAY TO THE ORDER OF John Doe $250.00
Two Hundred Fifty —— DOLLARS
E. K. Root

An effective and simple way of protecting a check

Holding the tire on the rim by air pressure is feasible

The longitudinal elasticity of the new tire permits the air to absorb a large percentage of the stresses which wear the common tire. When the new tire encounters a stone or other obstacle, thanks to its elasticity, it tends to fold about the obstacle and absorb its shape rather than to pass the shock on to the car or to accept damage to itself. This elasticity absorbs the traction wave, or forward movement of the car and eliminates tire heating.

Arranging clothing neatly

Combination Table and Desk

THE table which we illustrate is intended for the use of children. It may be used as an ordinary table, or part of it can be raised so as to form a desk.

A Welding Wrinkle

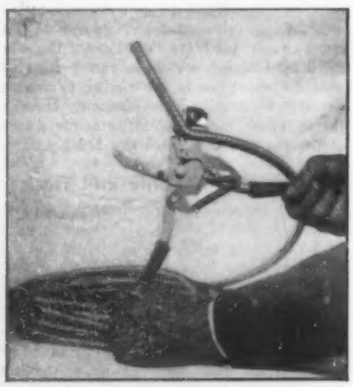
A PRINCIPLE to be observed in all oxy-acetylene welding operations is never to direct the torch flame upon the welding rod to melt it, says *Power*. The flame should be directed against the joint so as to form a puddle of molten metal. The welding rod should be melted by the heat of the puddle and the radiation from the torch flame. By always forming a puddle in the V and adding to it from the welding rod, using the heat of the puddle to melt the rod, the welding operator is reasonably sure of obtaining penetration and cohesion.

When the table is a desk

Left: **Canvas strips and letters are pasted on the pavement.** *Center:* **How the letters are applied.** *Right:* **Strips are great aids to traffic regulation**

Pasted Letters for Traffic Control

WHEN we visited the armory at the recent Safety Congress at Albany, we were struck with the simplicity and practicability of canvas letters which were pasted on the floor and we are now able to show our readers some excellent examples of how these letters work out in practice. Markings of various kinds are provided as well as letters. Arrows, curves for turns, et cetera enable almost any traffic problem to be solved. The letters come in pairs—back to back. The two letters or strips are separated at the top, then with a quick jerk they are pulled apart and are ready to be applied to the pavement—the surface of which must be perfectly dry and swept clean. The temperature, when applying the strips or letters, should be about 55 to 60 degrees Fahrenheit. A chalk line gives perfect alignment. The letters or strips are lined-up on the chalk line—the letters being arranged to form desired words. A one-quarter inch lap is provided. Then the edges are pressed down with the foot and the letters are ready to withstand the heaviest traffic which will not wear them out except after a period of three to five months or longer. The pavement markings look much more finished than if the letters were done by hand and the cost is less.



Breaking the cable's armor

Now Run by Electricity

NEARLY all the milling plants at the old tin mines of Cornwall, England, are now run by electricity, although steam is generally used for pumps and hoisting.

Exit the Armored-Cable Hatchet

THE hatchet is a time-honored tool for cutting armored cable. It bruises the armor, leaves burrs on the wire and mashes the insulation. A manufacturer of armored cable, realizing these difficulties, has brought out a tool that makes cutting armored cable easy for the contractor. The tool is first gripped on the cable, then the handles are opened as far as they will go. This serves to break the armor. The handles are then closed and the armor and the wire is cut. The cable slips out of the tool and then it is possible to slide off the armor.

Keeping Liquids Germ-Free

THE inventor of this device is shown here with one of the removable ice chambers she makes for pitchers, punch bowls, et cetera to eliminate possibility of getting impurities into the liquids from melting ice. The ice is confined in a detachable chamber which fits into the base of the bowl or pitcher.

Protection from Snow and Cold

THE device which we illustrate provides ample protection against snow, sleet, rain and extreme cold. These boots are both ankle length and knee length and are for wearing when using skis. They form a part of the ski itself. No snow can soak through so that the shoes or moccasins are kept dry. The boot—as we term it—is made of fabrikoid. A foot board is provided to which the foot harness is attached. This new article will be of great service in the northern part of the United States and in Canada.

Cooled, germ-free receptacles

Foot comfort and warmth for the winter sportsman

Eliminates Sprinkling

A NEW type of electric iron eliminates the need of sprinkling, as steam is provided from a water reservoir in the handle. It is worked like any hand iron. A simple conduit leads from the reservoir to the heated bottom plate. The steam does the dampening, prevents scorching, saves time. The device spreads moisture evenly through tiny holes in the bottom plate. This forms a mist-like film of moisture that is evenly distributed between the ironing surface and the garment, dampening and freshening the goods as the iron is used. Of course the added steaming feature does not in any way interfere with the iron for ordinary work.

New tool cutting the wires

This iron sprinkles clothes

many times better than in 1921

WITH four times less drain on your "A" batteries than the storage battery tube of five years ago, the filament of a Radiotron UX-201-A throws across to the plate five times as many electrons—a steady stream of tiny electrical charges that carry the song and speech. This is a big increase in efficiency!

And the Radiotron UX-201-A does not burn out—unless you apply a huge, excessive voltage. It does not die gradually, but keeps its efficiency almost to the very end of its life.

to get more power

—put an RCA power Radiotron UX-120, UX-171, or UX-210 in the last audio stage of your set.

to get more distance

(on a storage battery set)

—put the new special detector Radiotron UX-200-A in the detector socket.

• • •

RCA is not only making Radiotrons steadily better—but is further improving reception with these new special Radiotrons. Keep your set up to date.

These are but a few of the advances in vacuum tube making that have come from the laboratories of RCA and its associates—General Electric and Westinghouse. Unceasing research brings continual improvement in RCA Radiotrons, making possible ever better reception—at lowered cost.

RADIO CORPORATION OF AMERICA
New York Chicago
San Francisco

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Nitro-Glycerine Made Safer

OIL-WELL shooting, one of the most hazardous of occupations, has been relieved of some of its danger through the invention of a new non-metallic container for the nitro-glycerine used in the underground blasts.

In most oil fields of the world an explosion at the bottom of wells which have just been drilled into the petroleum-bearing sandstone stimulates the flow by shattering the rock and opening channels leading to the well opening. Subsequent blasts are placed in order to remove the paraffin which tends to clog the minute passages between the sand grains and to extend further the existing channels.

The old-fashioned "hell-wagon" that traversed the oil regions by night has given way to a motor truck, while the metal shell which contained the nitro-glycerine may give way to a paper shell such as shown above

Nitro-glycerine is universally used as the explosive. It is lowered into the wells in shells from three to six inches in diameter and from 40 inches to 11 feet or more in length.

From the first days of the oil industry these shells have been made of tin. But the undesirable features of that material led to a search for a superior material which extended over the last 20 years.

The greatest danger due to the use of tin tubes is in the generation of frictional heat while the shells of explosive are being lowered through the iron casing of the wells. It is not uncommon for premature blasts to occur from this cause, endangering lives of workmen and damaging or destroying wells which have cost many thousands of dollars to drill.

A new type of shell which has recently been invented is made from compressed paper impregnated with molten sulfur. Sulfur melts at a temperature below the firing point of nitro-glycerine. Therefore, the development of frictional heat softens the exterior of the sulfur shell and prevents the transmission of the high temperature to the explosive inside.

The new shell also possesses the asset of being highly frangible. When the explosion takes place it is rendered into bits. Being combustible, most of these fragments are consumed by the heat of the blast. Those that survive are so small that they do not aid in the tendency of wells to stop up or "bridge" with rock fragments blown up into the casing by the shot.

These bridges minimize or even nullify the effect of the explosion, as it is necessary for a well to clean itself immediately after the shot, through the action of its own flow of oil. Tin has a tendency to shred and these shreds often contribute directly to the formation of bridges.

The impregnated paper shell is made with end castings formed from a newly patented carbon-sulfur compound, the castings being firmly cemented in place. The new shells have a greater structural strength than tin and, it is claimed, are also more elastic, thus reducing the chances of premature explosions due to shocks received while they are being handled just before lowering them into wells.

* * *

Largest Metal Crystal Ever Made

THE crystal of copper shown in the accompanying illustration, somewhat resembling a projectile in appearance, is 17 inches long, 2¼ inches in diameter, and weighs slightly more than 12 pounds.

It was withdrawn from the electric furnace at a rate of one-quarter inch an hour. This permitted the atoms of copper to arrange themselves regularly throughout the entire piece of metal.

One of the outstanding properties of such single crystal copper is that it will conduct electricity 13 percent more efficiently than will ordinary copper, which is composed of tiny crystals in chaotic arrangement. Another unusual property of single crystals is that a rod of the metal can be bent easily. Having been bent, however, the single crystal is broken up into small crystals, and then it is as difficult to bend as is ordinary copper.

Numerous experiments and investigations are being conducted to determine the properties of single crystal metals.

In one of its remarkably compact and informative "Research Narratives" entitled, "Super Conducting Copper—a Tantalizing Achievement Which May Lead to Industrial Economies," the Engineering Foundation (New York) publishes the following statement contributed by L. A. Hawkins of the research laboratory of the General Electric Company at Schenectady, New York:

"Professor A. E. Kennelly, in his Research Narrative, 'A Retrospect in Research,' tells how Lord Kelvin in 1857 found that copper wire used in cable manufacture differed much in conductivity, and urged that transatlantic cables be made of high-conductivity copper—chemically pure metal, capable of transmitting current with much less loss than occurred in the usual, more or less impure, copper. This was one of the early applications of research to finding better electrical conductors.

"From that day to this, pure copper has been used almost exclusively for electrical transmission. The only known material with higher conductivity than pure copper is silver, a metal too costly for use in line wires.

"But in spite of this settled practice, interesting questions remained. Why is silver more conductive than copper? Why is copper, next to silver, more conductive than all other metals? Is its conductivity absolutely a fixed thing, or is it susceptible of increase by special treatment?

"A small increase in the conductivity of commercial copper would have great value. An increase of even ten percent would release for other fields an enormous tonnage of copper now used for transmitting power. The economic radius of all existing transmission systems would be increased ten percent, increasing by 21 percent the area served; or the underground cable subways of cities, so many of which are taxed to capacity with their loads of today, could without enlargement carry additional loads of ten percent.

"So, when Dr. W. P. Davey, of the research laboratory of the General Electric Company, found by calculations, based on the arrangement of the copper atoms which the X rays revealed, that copper composed of a single crystal should have a conductivity 14 percent greater than ordinary copper, greater than that of silver, possibilities of great scientific interest were disclosed. In order to check his calculations, Dr. Davey proceeded to devise apparatus for producing large single crystals of copper.

"The single crystals were made by very gradually heating and cooling pure copper in an electric furnace. When molten metal is quickly cooled, very small crystals are formed; if the melt is cooled slowly, the crystals are larger. Dr. Davey cooled the melt so slowly that only one crystal was formed, and that included all of the metal. By this method he was able to produce single crystals three-fourths of an inch in diameter and six inches long, and one that is 14 inches long.

Courtesy of General Electric Company

Dr. T. A. Wilson, of the research laboratory of the General Electric Company, holding the world's largest single crystal of copper

"The conductivity of these crystals was then measured, and, although the quantities involved were only 36/100,000ths of a volt and 18/1,000,000ths of an ohm, measurements by different methods were made which checked within one-quarter of one percent. The measured conductivity was 113 percent that of pure polycrystalline copper, within one percent of the calculated value.

"In a crystal, the atoms—the unit particles of the substance—are built up in regular fashion. The crystals of copper, for example, are made up of very tiny cubes, with atoms of copper at the corners and centers of the faces of each unit. The large crystals grow in such a direction that the atoms are arranged in columns along the length of the crystal. It is this regular arrangement of the atoms, which, it is believed, gives to the single crystals their superior conductivity when compared with ordinary (polycrystalline) copper, in which the crystals are small and the arrangement of these small crystals quite chaotic.

"There is reason to believe that the conductivity of copper crystals along another axis from that measured may be even 60 percent greater than the value for pure copper, but the growth of single crystals along this other axis has not yet been brought under control.

"Unfortunately, there is no immediate prospect of utilizing commercially this newly discovered high conductivity, for the single crystals are very delicate and difficult to manufacture.

"One of the first facts discovered about single-crystal copper was that the specimens could be bent double with one finger, but that strength was required to straighten them afterwards. A crystal of the size of a lead pencil, if given a jerking motion, bends like a stick of soft wax. Having been once bent, however, it acquires the properties of ordinary copper, for the bending has transformed the large crystal into a mass of smaller ones."

* * *

"Coffin Nails?"

Now that Prof. J. Rosslyn Earp, of Antioch College, has just investigated tobacco smoking among students and stated that he finds that lowered mental efficiency is a consequence of smoking, and since his findings have been published in most of the newspapers and many of the magazines of the land, some investigations made by Sir Humphrey Rolleston of the University of Cambridge, England, and published in the well-known medical journal, *The Lancet* (London) should be of increased interest. They are not inserted with any prejudice concerning tobacco, since the majority of the editors of the Scientific American, including the present writer, smoke.

Tobaccos vary considerably in their nicotine content, says Sir Humphrey, pipe mix-

(*Continued on page 372*)

DANDRUFF?

Now you can control it!

YOU need worry no more about dandruff, that unsightly nuisance, so embarrassing to both women and men.

As you probably know, dandruff is a germ disease that no intelligent, fastidious person can afford to neglect. Because so often it is a warning of more serious scalp trouble—possibly baldness.

There is one ideal treatment to control dandruff conditions—the systematic use of Listerine, the safe antiseptic. It really works wonders this way.

The use of Listerine for dandruff is not complicated. You simply douse it on your scalp, full strength, and massage thoroughly. You'll enjoy the cleansing refreshing effect. And you will be amazed to see how this treatment, followed systematically, does the trick.

Moreover, Listerine will not discolor the hair nor will it stain fabrics. And it is not greasy.

Try Listerine for dandruff. You'll be delighted with the results.

Lambert Pharmacal Co., St. Louis, U. S. A.

Well—it worked! For quite a while we challenged people to try Listerine Tooth Paste. Sales now show that when they try it they stick to it! LARGE TUBE—25 CENTS

LISTERINE

—and dandruff simply do not get along together

Plylock is a laminated product made from selected veneers of genuine Douglas Fir. It is not to be confused with ordinary commercial fir plywoods, for every piece is built to the most rigid standards. It is made in 3-ply, 5-ply and special thicknesses to meet individual needs.

These beautiful Plylock panels supply countless industrial needs

Manufacturers in many lines of industry are showing keen interest in Plylock, "wood that's stronger than wood". For Plylock panels have advantages never before combined in any one material; — great strength, light weight, freedom from cracking and checking, and most reasonable cost. Add this to the remarkable width of Plylock panels in proportion to their length (stock panels with unbroken outer grain may be had as large as 48 inches by 96 inches) and you see why Plylock is lowering costs and bettering quality in so many important industries.

If you make automobile bodies, trunks or cases, cabinets, doors, shelving, phonograph or radio sets, toys, desks or furniture, or any of dozens of allied lines, write at once for a copy of "The Pictured Story of Plylock" and full information about this material. Full size samples will gladly be supplied, gratis, for experimental and development work in your own plant, and our research department is at your service.

PORTLAND MANUFACTURING CO., PORTLAND, OREGON

Plywood makers for 27 years

PLYLOCK

"Wood that's *stronger* than wood"

3-ply Plylock cut away to show construction. Plylock is regularly made in 3 and 5 plies of finest Douglas Fir.

Send for this Book— Your Copy of "The Pictured Story of Plylock" is ready. Write for it.

tures having the highest. The nicotine content of the tobacco and its smoke do not, however, vary directly. *It is the way in which the tobacco is smoked and the degree of combustion (formation of carbon monoxide) that are the important factors.* Thus, Virginia cigarette tobacco contains 1.4 percent of nicotine, which is nearly twice as much nicotine as Manila cigar tobacco. Yet cigar smoke contains more than double the amount of nicotine found in cigarette smoke.

The smoke of Virginia cigarette tobacco contains only .06 percent nicotine when smoked in a cigarette. But when burnt in a pipe, 37 to 53 percent of the content of the smoke is nicotine, or several hundred times as much.

The degree of combustion—of which more later—is most complete in cigarettes, least in a pipe and midway in the case of cigars. In pipes as much as 70 or 80 percent of the nicotine in the tobacco may pass into the smoke, but a good deal depends on the length of the stem of the pipe. For example, a church-warden pipe with long stem allows the nicotine to cool and condense in the stem to such an extent that very little passes into the smoke.

Nicotine collects in the moist area of a cigar behind the burning tip and, if it does not undergo complete combustion, may be carried into the mouth by the hot smoke. Therefore a half-burned cigar should not be relighted. Thus, it has been stated that a smoker who relights a pipe or cigar absorbs more poison than he would from ten ordinary smokes.

According to Dixon, the smoke of one cigar contains as much nicotine as that of 12 to 18 cigarettes. The general opinion, says Sir Humphrey, is that cigarette smoking is the form likely to give the worst results; then cigars, and lastly, pipes. He reverses this order, saying the evil reputation of cigarettes has been ascribed to their patronage by unstable neurotics who are unable to stand cigars and pipes. Thus these critics have the cart before the horse.

However, two other reasons are given for the more evil influence of cigarette smoking, —many more cigarettes than pipes are smoked, and the smoke is inhaled. Thus nicotine and carbon monoxide are more certainly introduced into the body, and furfurol or furfuraldehyde, an artificial oil of ants, exerts its irritating effect, producing smoker's throat and smoker's cough.

According to Armstrong, cigarette smoke contains up to one percent of nicotine, *but more when smoking is rapid than slow.* A Havana cigar when smoked quickly gives as much as eight percent of carbon monoxide, or as much as there is in London city gas! The effects of cigarette smoking appear to be chiefly due to carbon monoxide (this is the poisonous gas that is discharged in the exhaust of a motor car due to incomplete combustion, often killing owners who run cars in enclosed garages); also pyridine (an alkaline solvent), furfurol and ammonia. But cigar smoke is powerful mainly on account of its nicotine.

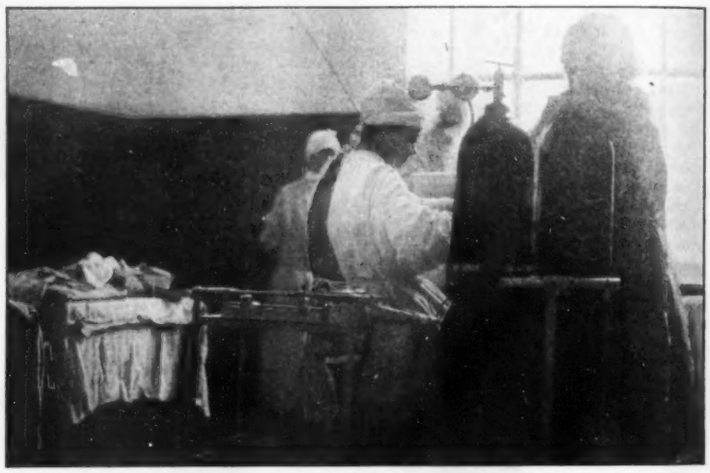
Oddly enough, the older methods of using tobacco, namely, chewing and snuffing, are said to be attended by little absorption of nicotine.

Everyone has noted the satisfying effects of smoking when hungry. It is explained thus: the motility or contractability of the stomach soon becomes paralyzed and remains so for an hour or so. And it is on this motility that the feeling of hunger depends.

* * *

Helping the Surgeon to See Red

WHEN we think of the hospital operating room we picture it with spotless white tile floor and wainscot, white upper wall and ceiling, and white enameled furnishings. White has always typified cleanliness and it was natural that the attempt to eliminate dirt and bacterial contamination in the operating room should have led to the choice of white. There is one other reason for choosing white. The maximum reflection of light necessary for surgical work is best obtained from white walls and ceiling.



Interior of an operating room at St. Luke's Hospital in San Francisco. The finish is in green instead of white as is customary in operating rooms

But despite these advantages of white, which experience has proved are largely theoretical, there are some very evident disadvantages. These have been overcome in some hospitals, according to Dr. J. Marion Read of San Francisco, by utilizing colors rather than white as a finish for the operating room. The colors used are dull French gray, dull ivory, olive green and dark "spinach" green.

One of the first hospitals in this country to depart from the customary white operating room was Saint Luke's Hospital in San Francisco. When the new hospital was constructed, the floor and wainscot of one of its operating rooms were finished in green tile. This was the idea of the chief surgeon, who called attention to the fact that the particular shade of green selected was dark or "spinach" green. This shade of green is the complementary color to hemoglobin or "blood" red.

In this fact is to be found the reason for departing from the conventional white as an environment for the surgeon. Its dazzling brightness is blinding to the surgeon's eyes when he raises them from the operating field where the predominating color is red. Complementary colors afford the greatest eye relief and, in this case, both theoretically and practically, dark green proves the most efficient in combating the color fatigue to which the surgeon is subjected. In addition to lessening color fatigue, complementary colors also intensify their opposites. Thus the operating field stands out more clearly in the surgeon's vision after gazing for a moment at green. To bring this relief and contrast closer to the surgeon's eyes, the wound is often surrounded by blue denim, or black towels instead of the usual white ones.

There are some very curious and interest-

ing facts regarding these two complementary shades. For example, green has long been recognized as restful to the eyes. This is illustrated by the use of green for eye shades, automobile sun-visors and many non-ornamental lamp-shades. Green also suggests coolness, perhaps because it is the predominating color in trees and grass. This thought brings to mind one of the most astonishing relationships in the world of nature, the similarity between the green pigment of plants and the red coloring matter in the blood of animals.

Chlorophyll is the chemical substance which gives all green plants their color, while hematin is responsible for the red color of blood. These are both very complex substances, yet chemical analysis reveals that they are almost identical in composition. The chief and practically the only difference between them is that hematin has one atom of iron in the molecule, while chlorophyll has none. It is probably this atom of iron which is responsible for the difference in color between "chlorophyll green" and hemoglobin or "blood red."

These green and red chemical compounds, besides being essential to the respiration of plants and animals, respectively, are also important in the physiology of vision. That is why the esthetic white operating room gives way to the more practical green one in which natural conditions are simulated and vision is aided.

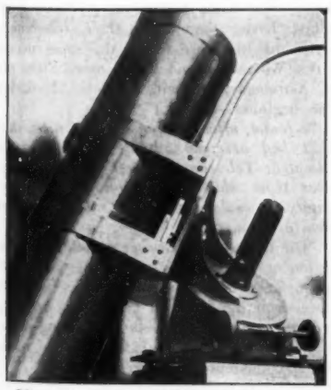
* * *

Real Estate Broker Makes Interesting Telescope

To the editors, it is an everlasting source of marvel that so many expert mechanics exist among those whose vocations have no connection with skilled manual work. For example, the telescope made by H. L. Rogers, 10 Adelaide Street, Toronto, Ontario, is a credit to its maker. At our request, Mr. Rogers submitted the following letter describing his telescope.

"I enclose two snapshots of a six-inch reflecting telescope, the construction of which was inspired and directed by your articles by Russell W. Porter, and by your wonderful little book on the subject.

"As I have a rather poor horizon near my home I decided to construct a telescope which would be more or less portable, and so I built the equatorial mounting of one-quarter inch brass plate throughout, feeling that this would give me a fairly light, and yet strong, instrument. Where the plates are joined at right angles, I used a home-made end milling cutter with a 7/32-inch central hole and milled dowels on the edge



Mounting of the Rogers telescope

of the upright plates. These were rivetted through adjoining plates, forming a very strong and neat joint. The milling cutter was used to clean out the spaces between the dowels.

"The construction of the mounting follows fairly closely the principle outlined by Mr. Porter on page 31, 'Amateur Telescope Making.' The photographs show a slow motion of the equatorial plate. This has proved very satisfactory and rigid.

"The spindle of the slow motion is a three-eighth inch brass rod, threaded with

Feel the Thickness of this Page

—then imagine it split *twelve* times

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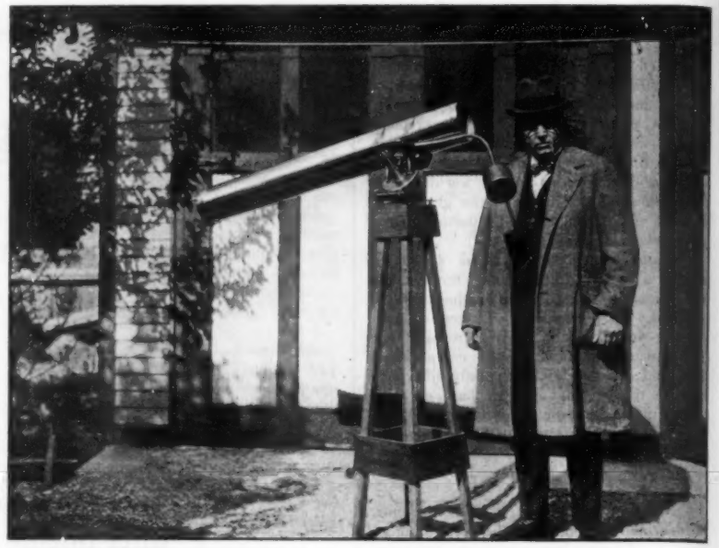


Mr. Rogers' equatorial telescope, made almost entirely of brass

24 threads to the inch from end to end, with a steel boss threaded and soldered to the middle of the brass rod, engaging three teeth on the steel slow-motion plate. The latter is of about one-sixteenth inch cold rolled steel. The rod is supported by two one-half inch blocks and is threaded through them. The adjusting wheels are threaded and soldered to the spindle, as shown in the photograph. This turned out to be a suitable slow motion.

"I had intended using a slow motion only on the equatorial plate but the type above described proved so satisfactory that I have since added a similar slow motion around the declination axis, which gives a very fine control of the instrument.

"Some difficulty was experienced in anchoring the 9/16-inch steel rod for the balancing weight. This was done as follows: the rod runs through two oak distance-pieces which hold the tube in place. A flat area about three inches long was filed on the rod. Engaging this flat is a one-quarter inch steel plate. This clamps the rod very securely to the base plate, as it has such a large bearing on it. The telescope tube is held by 1¼-inch brass bands looped at their ends to take one-quarter inch brass screws and nuts.

The flange for the eyepiece tube was easily swaged out of a piece of 3/32-inch brass plate finished in the lathe.

"The telescope tube is built up of 26-gage, hard-rolled brass fastened with small round-head screws and nuts. Solder is also sweated into the joints, making a very strong and light tube.

"A collar of the same material as the holding bands was soldered and riveted to each end of the tube. At the bottom end of the telescope tube are three projecting one-quarter inch studs with two lock nuts on them to form adjustable stops, against which the three arms of the speculum cell are held by wing nuts. The speculum cell is built up of brass with a heavy spring brass collar sprung to fit the inside of the cell walls. This holds the speculum firmly and rigidly on a bed made of filter paper and a thin sheet of wood. [Just firmly is enough. If held too firmly the pressure will distort the optical figure of any mirror.—Editor.] Later I fastened the collar with small countersunk screws in order to prevent the mirror from rattling loose.

"The diagonal mirror in the telescope tube is held in a tripod built up of sheet brass with a three-eighth inch adjustable hole through the center. The mirror itself is mounted on a plate which in turn is held by a three-eighth inch round brass rod which fits in the central hole of the tripod, thus providing an axial and up and down movement in relation to the telescope tube. The second diagonal mirror is clamped between two pieces of brass tube with 45-degree ends which are split and sprung into the inside of the eyepiece tube, giving an adjustable, yet firm mounting for this mirror.

"The base plate of the mounting is equipped with adjustable feet. The oak stand shown in the photograph has proved very satisfactory and as rigid as one could expect. I intend to fit the stand with plumb and compass, for rough adjustment.

"I have not kept precise track of the expense for materials but I believe I could safely say that the expense would not be more than between 40 to 50 dollars—possibly less.

"All brass parts have a brushed finish, polished and lacquered, and the instrument has quite an attractive appearance.

"The blocks holding the equatorial slow motion each consist of two pieces of brass soldered together to make one-half inch thickness, and the joint is quite invisible.

"The instrument has been in operation only about one week and I have already examined the rings of Saturn and a wonderfully beautiful image of the moon, with perfect definition. It is astonishing how many stars make their appearance in the instrument which are not visible to the naked eye, and I am now faced with the necessity of brushing up my astronomy in order to know what I am looking at. [Many amateurs, having completed their telescopes, write that they are facing the same necessity. We recommend Fath's new "Elements of Astronomy," a lucid, up-to-date book for the beginner.—Editor.]

"*I found, after wasting a lot of time, that if I had observed all the instructions in 'Amateur Telescope Making' very carefully, even those which seemed altogether unnecessary, I would have saved myself a great deal of time.*

"On the whole, however, making the instrument has proved a very interesting recreation, and I am more than pleased with the success of it. I am an amateur at running a lathe and there is absolutely nothing about the mounting or tube that cannot be made by any amateur with average ability."

* * *

Rain and Snow Fertilize Soil

RAIN and snow water the fields and meadows, but not many people know, says Dr. Frank T. Shutt, Dominion chemist of the Canadian Department of Agriculture, that they also fertilize the soil. They wash down out of the air and into the earth enough nitrogenous substances to make a real difference in the farmer's fertilizer bill. In the vicinity of Ottawa, the amount of such fertilizer added free of charge to the soil each year has been measured and found to be equivalent to 44 pounds per acre of

expensive imported Chile saltpeter. There is, after all, a "pot of gold at the rainbow's end," at least for the farmer.

"The Canadian experiment," Dr. Shutt said, "covered a period of seventeen years and has given valuable information on the part played by rain and snow in maintaining soil fertility. Precipitation also plays an important role in purifying the atmosphere, and the Ottawa experiment has approximately measured the extent of this useful work."

Every rain and snowfall for 17 years that yielded enough for experimentation was analyzed, Dr. Shutt explained, and the amounts of free ammonia, nitrates, nitrites, and albuminoid ammonia were measured. These are the forms in which occur the sort of nitrogen of the air which can be assimilated by plants as food.

Although air is normally four-fifths nitrogen itself, it is only the small quantities of this substance already in combination with other chemical elements that are of use to plant life. The enormous quantity of nitrogen gas in the air is useless, and plants may starve for nitrogen while immersed in an atmosphere of it.

The "combined" forms of nitrogen enter the air in various ways, Dr. Shutt said. Plant and animal matter contains nitrogen, and ammonia gas forms and goes into the atmosphere when these decompose. Smoke from houses and factories spills its compound nitrogen into the air, and lightning bolts in thunderstorms smash atoms of hydrogen and nitrogen together to form ammonia, just as the difficult electrical "arc process" does in the man-made laboratory. These substances are sooner or later washed out of the air into the soil.

Most of the combined nitrogen of the air occurs as free ammonia, and this is always much larger after forest or bush fires. There has also been a steady increase in recent years in ammonia in the air, Dr. Shutt said, because of the increased use of soft coal.

The amount of total nitrogen brought down to the soil out of the sky each year varies greatly, according to Dr. Shutt, and it is not always possible to account for the variations. Around Ottawa, the average amount of nitrogen thus added to the soil is from six to seven pounds per acre in a year. During one year this amount jumped to more than 11 pounds. This was believed to be due to the new factories in the vicinity.

Snow is decidedly poorer in nitrogen than rain, it was found. It carries only one-half as much free ammonia and also considerably less of the other nitrogen compounds. Snow carries only about half as much useful nitrogen as an equal amount of rain, and as there is more rain than snow during the year, rain contributes nearly six pounds of nitrogen to the soil while snow gives a little more than one pound.—*Science Service.*

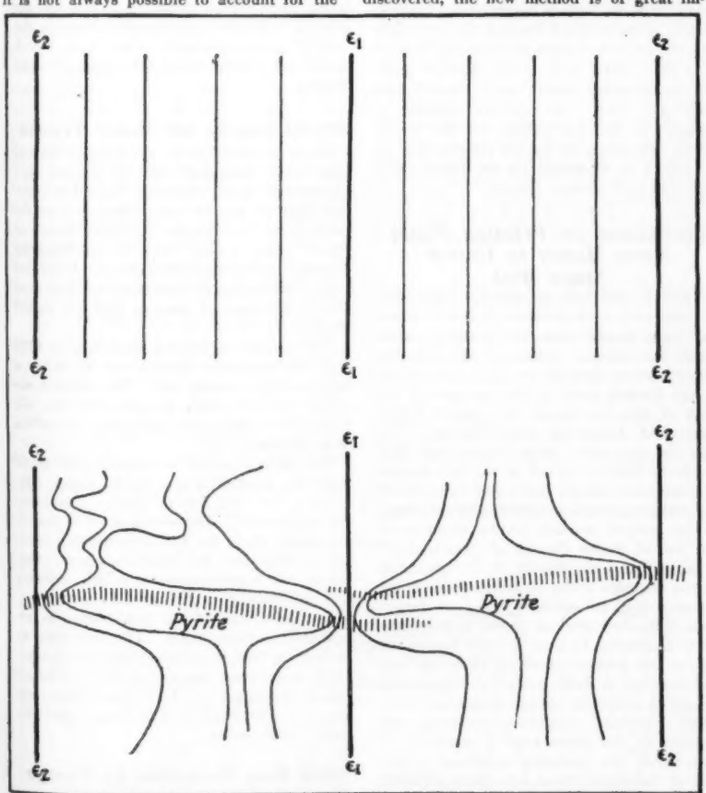
* * *

Electrical Prospecting Method Finds Gold Deposit

A GOLD ore deposit thought to be of gigantic proportions has been discovered at Boliden, Sweden, in the province of Vesterbotten, not far from the Arctic Circle, according to Dr. Axel Gavelin, head of the Swedish Geological Survey. Electrical prospecting methods developed by Hans Lundberg and Karl Sundberg, mining engineers, are responsible for the find. It comprises 34 ore bodies, all covered by glacial drift, swamps or lakes.

Discussing the find, Dr. Gavelin said it was all the more interesting because of the unique methods by which it was discovered. The electrical "divining-rod" is no poor relation to the "witching rods" found throughout the world, he said, for the new electrical device is based strictly upon established scientific principles and no element of mysticism enters into its operation. A parallel electrical field is conducted into the earth and equipotential lines in the surface are fixed by the use of extremely sensitive telephones. By delicate electrical instruments it is possible to chart the field electromagnetically. The disturbances in the electrical field thus shown make it possible to locate ores because of their electrical properties.

As most of the outcroppings of ore to the surface of the earth have long since been discovered, the new method is of great im-



Courtesy "Engineering and Mining Journal Press"

How the ore body is located, using two movable electric probes connected with a source of several thousand volts, alternating current. If the rocks below the surface were homogeneous, the lines of equal voltage would be straight, (see upper half of drawing). If an ore body dies concealed, these lines are distorted by it, (lower half of drawing)

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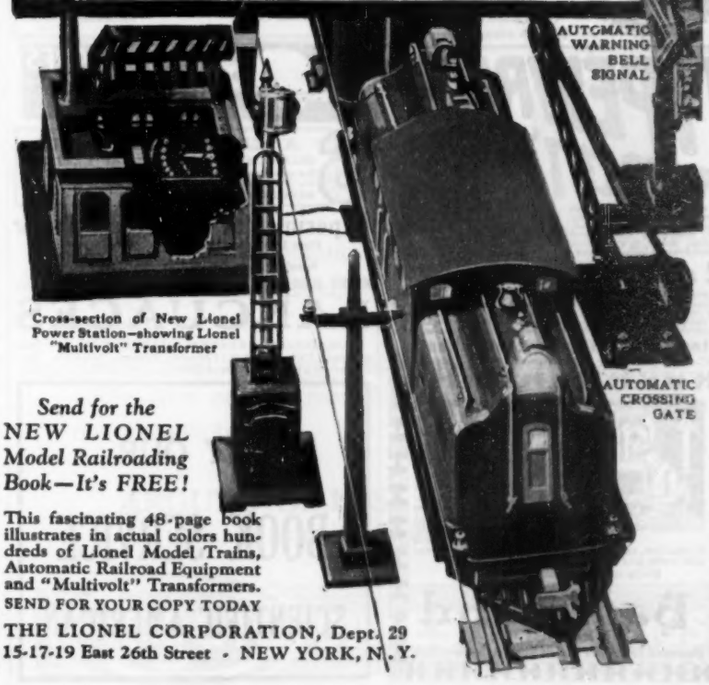

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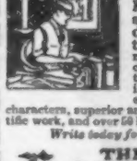

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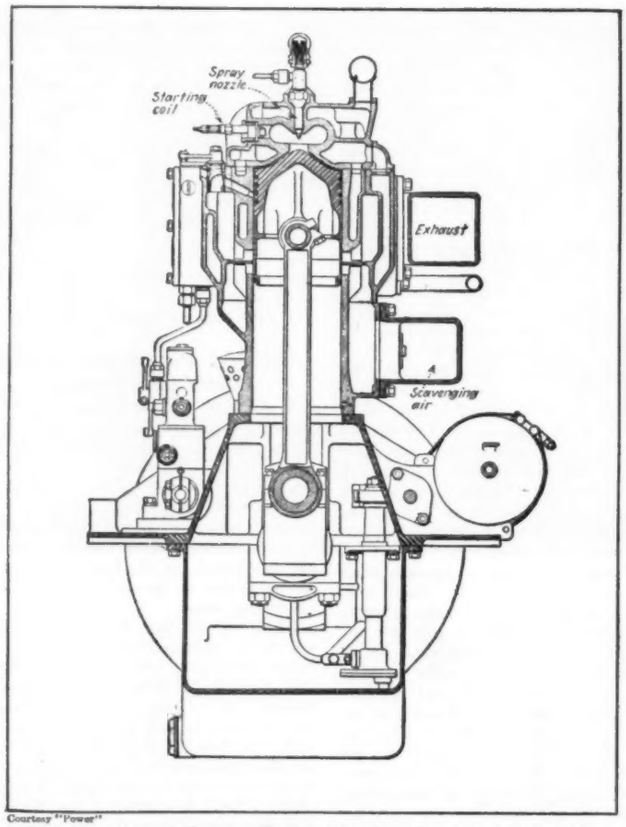


Courtesy "Power"

A cross-section of the new French Diesel engine for motor trucks

portance at this time, Dr. Gavelin pointed out, because with the system, it has been found possible to locate ores at barren and rocky places where the existence of ores could not possibly be predicted by any other known method.

The extent of the new find has not been determined, no borings having as yet "struck bottom" or penetrated through the ore. One deposit was traced through ice to the bottom of a lake, thirty feet down. Besides gold, the ore contains silver, copper, sulfur, arsenic and iron. The arsenic deposit is thought to be the richest in the whole world. Preparations for the construction of a railroad to Skelleftea on the Baltic coast have begun.—*Science Service.*

* * *

Chromium on Printing Plates Saves Money in United States Mint

THAT a thin film of metallic chromium, electroplated upon a metal currency printing plate, would cause the plates to withstand the wearing action of the printing presses better than if the plates are made of the hardest steel, is the outcome of the tests of this process at the United States Bureau of Engraving and Printing. Not only do the plates wear longer, but they cause the intricate detail of the bill designs to come more sharply into relief, thus affording further protection against counterfeiting.

The method, worked out by chemists of the United States Bureau of Standards in collaboration with officials of the engraving bureau, deposits a film of metallic chromium, thinner than an ordinary sheet of paper, upon a finished steel or copper-nickel plate. After machining to sizes suitable for clamping on the presses, of which there are several hundred in daily service, the plates are placed in a special chromium plating bath. Under carefully controlled conditions the deposits on the plates have a beautiful silvery lustre, the operation requiring, in the case of the nickel plates, only thirty minutes, and of steel, twice as long. Harder than the hardest steel, the plates yield from 50,000 to 100,000 impressions of eight bills each, and in some cases considerably higher numbers. An additional advantage of the method has been the discovery that after such a run, the chromium film may be removed chemically and a new film put on, thus obviating the necessity of making a new plate.

It is predicted that the method, already used to some extent on plates from which labels and similar commercial articles are printed, will find a much wider usage in the "shells" or electrotyper's plates from which books and periodicals are produced.—*Science Service.*

* * *

Diesel Engine for Motor Trucks

WHAT is stated to be the lightest oil engine built, weighing only 11 pounds per horsepower and consuming less than one-half pint of gas oil per horsepower is described in the August 3, 1926, issue of *Power* (New York). This is the Peugeot-Tartrais engine, built in France. A similar engine is about to be put on the market, says *Power*, for use—at least at first—in motor trucks.

The original engine was built late in 1922 and was employed immediately to drive a five-passenger touring car. The mileage obtained was 14¾ miles per gallon of this oil, which, of course, costs much less per gallon than gasoline.

The design proved so complicated as to make the production cost of the engine prohibitive, but after several changes, including the increase of compression to 475 pounds per square inch, the fuel consumption came out at .45 pounds per horsepower-hour. (One pound per horsepower-hour is the ordinary fuel consumption of the gasoline motor.)

A cross-section of the new engine is reproduced in these pages. The only type to be built at first is a two-cylinder, two-stroke-cycle, motor-truck engine, of 50 to 55 horsepower maximum at 1,400 revolutions per minute. The bore is 4.73 inches and the stroke 5.906 inches.

* * *

Odd Boat Propelled by Pumps

ONE of the favorite dreams of the impractical, would-be inventor is the jet-propelled vessel. In this type there is a tunnel extending forward and aft through the ship, and open to the water at either end. Some-

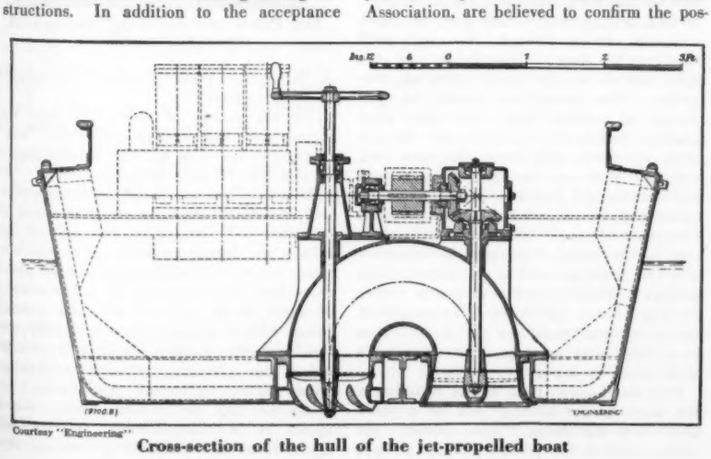
where in its length a pump is mounted and the ship is propelled by reaction from the current of water forced out behind. This method works but it is not as efficient as the ordinary screw propeller—that is the real fly in the ointment. However, such a craft has been built in England, for use under circumstances where the matter of relative efficiency is far outweighed by special circumstances.

"There are," says *Engineering* (London), "some exceptional cases of transport by water, when it is necessary to provide for a much greater flexibility in maneuvering than is usually obtainable with ordinary types of craft and propulsive machinery. Recently such conditions had to be met by a ferry boat for transporting passengers at the Royal Albert Dock, London, and a solution was found in an application of the Gill hydraulic propulsion system.

"It was found necessary in this ferry service to provide a small vessel capable of moving in any direction, either ahead or astern, and at any angle up to broadside on. A condition, which was imposed on the designers, was that the craft should be handled entirely by one man from a position at the forward end of the hull. No form of rudder, screw or other outboard projection was allowable, because of the liability of such devices to foul obstructions. The stipulation also was made that the boat should be able to work its way into very confined spaces, such as between barges and vessels at moorings or lying alongside the quay walls. Further it had to be capable of being held against quay-side steps or stages without the necessity for tying up. All the propulsion and steering mechanism had to be such as to be entirely free from possible troubles due to working in water encumbered with floating debris, ropes and other obstructions."

In these columns we reproduce from *Engineering* a cross-sectional drawing of the craft which was designed and constructed to fit the circumstances named above. The hull measures 30 feet by eight feet and is built of steel. It is propelled by a three-cylinder internal combustion engine which is outlined in the drawing. This engine is mounted athwartship and is geared to the vertical shaft of the pump by means of bevel gears. When the impeller at the bottom is rotated, the water is drawn up into the gooseneck tube shown in the drawing. It then circles up and around and issues from the deflection valve shown at the bottom on the left. This is simply a system of vanes for directing the outgoing current of water, and it can be swung entirely around in a circle by means of the handle shown at the top of its vertical shaft. By means of this handle the vessel can be maneuvered by one man. In fact the vessel described is strictly a one-man craft.

The boat has been tested and is said to be performing satisfactorily. "A considerable margin was found to exist over all the stipulations regarding speed, maneuvering and carrying capacity," says *Engineering*. "Satisfactory results were also obtained in regard to freedom from fouling among obstructions. In addition to the acceptance trials, tests were made to determine the dead pull exerted by the vessel when under power, with the complete range of running up to the normal duty. These tests showed that the old empirical rule that a pull of a ton should be obtained with tugs and similar craft for every 100 horsepower supplied to the shaft was complied with."



Courtesy "Engineering"

Cross-section of the hull of the jet-propelled boat

* * *

Accidental Discoveries in Industrial Science

THE story of how an Italian laborer, seated on a box eating his lunch in a plating plant, made a lasting contribution to his employer and to science, is told by Dr. William Blum, chemist of the United States Bureau of Standards and president of the American Electrochemical Society.

Officials of the company in question, makers of phonograph records, upon noting a marked increase in the hardness of the copper disks from which phonograph records are stamped, subsequently sent samples of the plating bath for analysis, which revealed that organic matter was present.

At a complete loss to explain the presence of any foreign matter in their electrolytes used for depositing copper electrically, a careful inquiry developed the fact that an Italian laborer had playfully flipped a piece of cheese at a fellow worker, the cheese missing its mark and falling into the tank where the metallic disks containing phonographic records were being plated. The phonograph company found that the hardening effect was due to the casein in the cheese, which material they therefore have continued to add to their solutions. The increased hardness of the copper allows a considerable saving because more records can be stamped in molten wax from the harder disks.

At another plant, in the research laboratories of General Motors, tests were being conducted to determine the cause of knocking in gasoline motors. One of the chemists conceived a brilliant idea: possibly knocking in motors was due in some way to the colors present inside the cylinder during combustion. Going to the chemical storeroom, he asked for some colored chemical soluble in gasoline. Out of some 10,000 at hand, the storekeeper gave him iodine, the only chemical in the lot which had the property of eliminating knocking! The color guess was wrong; but due to the happy circumstance of picking up iodine it was possible to solve the riddle of knocking in gasoline motors, and to work out the theory of anti-detonants which, it is believed, will bring about revolutionary changes in the design of internal combustion engines.—*Science Service.*

* * *

Automobile Exhaust Gas Harmful to Police

How much automobile exhaust gas does a busy traffic policeman inhale in a day? A little too much, according to tests made on over 30 patrolmen stationed at lively corners. Results of these tests, which have just been reported to the American Medical Association, are believed to confirm the pos-

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sibility that such workers might be inhaling enough of the dangerous carbon monoxide gas to affect their bodily condition.

The investigation was conducted by Dr. Elizabeth D. Wilson, Dr. H. R. Owen, and Miss Irene Gates, all of Philadelphia, Pennsylvania, and Wilfred T. Dawson, of Galveston, Texas. They report that after eight hours spent close to automobile fumes, some of the traffic policemen had enough carbon monoxide in their blood to cause slight headache and quickened pulse rate. In some cases, running up stairs was followed by dizziness and dimness of vision. The carbon monoxide taken into the system is usually eliminated from the blood by the next morning, they find. But they suggest that if the condition should become severe and troublesome it may be necessary for police departments to shorten the hours of duty in crowded sections of a city.

The investigators state that in the past few years a number of traffic officers in Philadelphia have complained of headache, slight nausea, and muscular weakness at the end of the day after duty in the most congested mercantile districts of the city, and that these symptoms might be traced to carbon monoxide.—*Science Service.*

Courtesy of the American Museum of Natural History

The tiny five-toed *Eohippus* of the Eocene Epoch, perhaps 55,000,000, years ago, compared in size with the skull of a modern horse

Man and His Horse—Whence?

Two new books which the reviewer treats together only because they were read together are: "The Pedigree of the Human Race," by Prof. H. H. Wilder (Henry Holt and Company, $3.25), and "The Evolution of the Horse," by Prof. F. B. Loomis (Marshall Jones, $3.00).

New books about evolution keep on arriving, yet each seems to fill a previously unoccupied niche. Professor Wilder's book covers the evolution of man and his ancestors from the Permian Period reptile evolving into the ancestral mammal. Its main stress, in fact, is laid on the early roots of man's evolution, down through the anthropoid stages, rather than on the already well covered subject of the early races of man proper. This is a book mainly for two classes of readers: those who have read popular books on evolution and thought them superficial, and those who have read scientific works on the early races of man and have thereby had their curiosity aroused concerning the various stages that preceded this phase of man's ancestry. The book is not, in the main, elementary in treatment and the previous reading of even a little geology and zoology would doubtless render its pages more significant. The reader of rather studious tendencies will find this an invaluable mine of organized information from which to draw.

Professor Loomis' book on the evolution of the horse is considerably less of a study book than the above. "This volume," the author says in his preface, "is an attempt to describe in as simple terms as the writer can command, the story of the evolution of the horse. It is hoped to present the specimens and our ideas about them, so that the reader will have a picture of the whole history, and be able to place in it such details as he may find in museums, or in the wide open country." The reviewer believes that Professor Loomis has succeeded in realizing the hope thus expressed, for the language of his book is, in the main, non-technical and easy. In fact, one obtains the impression that he is listening to an able but modest authority who might be seated on a veranda of a summer's evening, rather informally telling the fascinating story of the vicissitudes through which a little five-toed animal of the Eocene Epoch passed while evolving into numerous equine species, most of which are now extinct.

If anyone has ever wished that he could drop work and go west to dig fossils of horses and various extinct animals he will relish this book, for that is what its author has been doing for years. In it, he presents a clear picture of the methods by which this romantic quest is performed. Since the evolution of the horse is known better and in more detail, than that of any other animal except possibly, the camel and the elephant, it can be truthfully said that Professor Loomis not only knows how to tell a plain story but has a real story to tell.

In each of the works mentioned above there are a few slips, but they are comparatively too trifling to mention, in view of the general excellence of the rest.

* * *

A New Springfield Telescope Mounting, Large Size

THOSE of the amateur telescope makers who have taken interest in the so-called "Springfield" type of mounting for telescopes having a fixed eyepiece, will doubtless be further interested in the telescope of that type recently constructed by Donald Alden Patch, of 38 Crescent Street, Springfield, Vermont. Mr. Patch is a new initiate of the "Telescope Makers of Springfield."

Mr. Patch and his large Springfield equatorial mounting

A photograph of his telescope is reproduced in these columns.

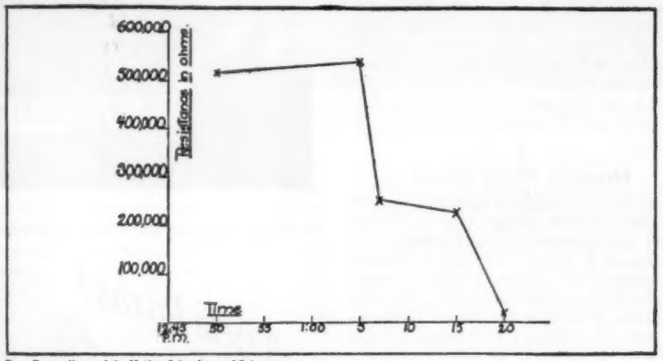
For the benefit of those who have not already become inoculated with the "bug" of amateur telescope making, an explanation of this type of mounting is in place. The light from a star passes down the open tube, and is reflected up again from a mirror at the lower end. Due to the concavity of this mirror, the light returns as a cone which in the present case would reach a point about even with the open end of the big tube. However, in this type of telescope a small prism with a diagonal face is rigidly suspended inside of the tube, in line with its axis. This prism turns the cone of light at right angles. A second prism placed directly beneath the eyepiece tube (which shows in the illustration), receives and again turns the diminishing cone of rays

upward directly into the eye of the observer.

The virtue of this arrangement is, that no matter what the position of the tube, the prisms send the image of the star to the eye of the observer without forcing him to contort his body like an acrobat. He is always looking comfortably down, as if through a microscope. This type of mounting was originated by Russell W. Porter of Springfield, Vermont, and several satisfactory telescopes that work on this principle have already been made. For example, one of the smaller size having a six-inch mirror is shown on page 212 of the September issue of the Scientific American.

Mr. Patch has now completed a mounting of the original Springfield type but heavier, permitting the use of a ten-inch or a twelve-inch mirror. The sketches on pages 32-33 of "Amateur Telescope Making" show this size. Mr. Patch posed as the model for these sketches when they were originally made. His present mirror is 8½ inches in diameter, and its focal length is 60 inches. The mounting is made of cast iron, although bronze castings may be obtained. The blueprints of this larger size of Springfield mounting show little variation from those of the smaller size, the principle being the same in each case. The rod which extends to the left carries a counterweight which could not be included in the picture.

Numerous inquiries concerning the manner of subdividing the setting circles of small telescopes having reached the editor, it may be said that ordinarily, the declination circle should be divided into single degrees and the polar or hour circle into



From Proceedings of the National Academy of Sciences

How the nerves control electrical resistance

15-degree divisions, each of which is again subdivided into six equal parts. Since the earth revolves 15 degrees in 60 minutes of time, these 15-degree divisions correspond to one hour, and each of their six-part subdivisions corresponds exactly to ten minutes of time.

Mr. Patch's telescope is solidly mounted on a concrete pedestal but may be taken in at night. He has run a duplex electric light wire through a buried conduit to the pedestal, and thus he has light at the telescope when he needs it. A telescope of this general size will magnify from about 60 diameters (using a one-inch eyepiece) to 120 diameters (using a one-half inch eyepiece) under atmospheric conditions obtaining in the east. In parts of the west where the atmosphere is not so hazy, a stronger, one-fourth inch eyepiece giving 240 diameters, could safely be used. Occasionally, this size may be used in the east.

* * *

Sleep Tested Electrically

THAT the electrical resistance of the body is markedly increased during sleep and that the quality of our sleep may be measured and studied experimentally by electrical methods, is the remarkable discovery made by Dr. Curt P. Richter of the Psychobiological Laboratory at Johns Hopkins Hospital (Baltimore) and described in the March, 1926, *Proceedings of the National Academy of Sciences* (Washington). In one case the onset of sleep automatically raised the electrical resistance of the body from 30,000 ohms to 500,000 ohms.

Our knowledge of the changes which take place in the body during sleep is still very limited, says Dr. Richter. Although there has been almost no experimental investigation of sleep, it has been the topic of an almost endless number of theories and speculations. Scientists knew—or rather thought they knew—that the depth of sleep reaches a maximum before the end of the second hour, and then rapidly decreases again to a low level, at which it remains, with small fluctuations, until the end of the sleep period.

We have all heard statements similar to the above, but Dr. Richter characterizes them as fallacies. When the tests from which this fallacy took growth were made, years ago, the subjects were constantly under a strain, waiting to be awakened, and accordingly the sleep was never normal. Dr. Richter avoided this factor in his experiments. His records were obtained by measuring the resistance offered to the passage of an imperceptible galvanic current from one hand to the other, using special zinc electrodes, covered with paste made by mixing kaolin with saturated zinc sulfate solution. These can be easily attached and removed, usually without interrupting sleep. The resistance was measured with a string galvanometer.

By means of the equipment described, Dr. Richter demonstrated conclusively an unusually interesting fact—that the resistance is localized almost entirely in the skin of the body. A puncture through the skin with a needle, even the finest, reduces the resistance instantaneously practically to zero. As shown in the graph reproduced, the resistance measured from back of the left hand to back of the right hand, remained steadily at over 500,000 ohms from 12:48 P.M. to 1:05 P.M. At this instant, a hole through the skin of the left hand caused a drop of 250,000 ohms. At 1:16 P.M., a hole punctured through the skin of the other hand caused a drop to 15,000 ohms.

Further experiments on monkeys, in which the nerves to the hands and feet were cut, demonstrated that the resistance of the palms of the hands and feet is dependent upon and is regulated by nervous impulses (although the backs of these extremities show no such relation). When the nerves were cut, the resistance jumped from 40,000 ohms to 990,000 ohms.

Some people sleep lightly, others can be awakened only by a thorough pummeling. Both types were tested, with the discovery that the resistance of the body is a true and corresponding test of the depth of sleep. That is, those that respond to slight noises with changes in breathing, sighs, and so on, showed low resistance during sleep. Those who were oblivious to all disturbances maintained high resistance.

Awakening, however sudden, brings an instant drop in resistance. Dr. Richter writes: "Several similar observations were made on a monkey, which, while held in the lap of an assistant in a darkened room, slept fitfully. The resistance followed the change in sleep so closely that it was possible to state quite accurately, without seeing the animal at all, whether it was awake, drowsing, or asleep, simply on a basis of the resistance readings."

With the typical true scientist's caution in the interpretation of results, Dr. Richter says it is not yet known whether in sleep

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we deal with an interruption of the nervous impulses, or with the effect of an inhibitory process. The results obtained with the skin of the back of the hands varied with the persons under test, and this suggests that there are two kinds of sleep, a quiet, relaxed sleep, and a strained sleep with muscular activity.

* * *

In Fond Memory of a Faithful Pair of "Pants"

How a prospector made a canoe out of his own trousers, and, trouserless, braved the incessant torments of the indefatigable arctic mosquito, in order to save himself from sure starvation, is the amusing account sent us by a reader from Alaska.

Faced with the alternative of starving if no transportation facility could be found, a handy prospector constructed this canoe, *Faith, Hope and Charity*, covering the framework with numerous "et ceteras"

Last summer this young mining engineer set out from Fairbanks, in the interior of Alaska, for a prospecting trip in the heart of the Arctic Mountains, several hundred miles north of that far-flung center of civilization. The upward trip was made by airplane, motor boat, canoe and raft, as well as with the aid of Indian packers and malamute dogs.

This view of *Faith, Hope and Charity* shows the interior and the constructional details of the boat

After several weeks in company with an Indian chief and the four dogs, prospecting for gold in the long range of mountains that borders the Arctic Ocean, the "grub" supply of the party gave out. If they were not soon to starve, a hasty return must be made. Not wishing to sacrifice their valuable dogs for food it was decided that the Indian, with the few remaining pounds of food, should retrace the journey on foot as far as Arctic Village. The white man would attempt to go by water, and since it would be a down-river journey, he should be able to do without much food.

But how to obtain the necessary canoe? Boat-making materials were not to be had in this barren country. Yet a craft of a sort—not beautiful, not especially seaworthy—was hastily made.

The ribs and strakes were of willow saplings tied together with grass. Over this framework was stretched a sort of patchwork or "Joseph's Coat," consisting of the following: one sun-shade, one "parka," one pair of overalls, and one pair of underalls. These sundry garments and fabrics were all sewed together and then daubed with caribou fat in an effort to make them waterproof. The resulting sheet was then attached to the outside of the willow framework.

In this shaky craft the plucky adventurer started on the long trip down the notoriously turbulent Sheenjak River.

After many days of peril and privation, and especially of constant, trouserless battle against the innumerable hordes of mosquitos that infest the far north, the hungry prospector finally reached the Yukon and a civilized community. For the most part, he says, he was clothed in a black beard and a head-net.

Food was his second request; his first was for a pair of "pants."

* * *

Oranges Make Bones

WHY is it that modern, intelligent mothers feed their children orange juice? Because orange juice contains noteworthy amounts of vitamins, A B and C. The lack of vitamin A leads to rickets and a lowered resistance to tubercle and other infections. The lack of vitamin B leads to the disease known as beri-beri. A deficiency of Vitamin C leads to scurvy.

Work performed at the University of Chicago last year showed, according to the *Journal of the American Medical Association* (Chicago), that children who were fed supplementary school-hour meals which included oranges gained in weight to a far greater extent than could be accounted for by the value of the food fuel derived from the 20 to 23 ounces of unstrained citrus fruit juice administered daily.

It was noted that calcium assimilation was decidedly benefited when oranges formed a part of the diet, *the increased retention being considerably greater than the calcium in the oranges.* (Calcium is a bone-forming element.) The increase of phosphorus retention was even more marked than that of calcium, more than three times as much phosphorus being assimilated when orange juice was added. The magnesium retention was also increased.

What, then, is the significance of these remarkable statements, which on first thought do not even seem reasonable? How could more calcium, phosphorus and magnesium be assimilated than the orange itself contains? There is some as yet unknown or half-understood effect which the vitamins produce, by which, in their presence, bone-forming elements may be absorbed from other foods. Various theories have been advanced to explain this, but these should possibly not be advanced outside of medical journals at present. Until more definite knowledge of the causes is settled on we must rest content to know the fact, which is undeniable, that orange juice does greatly aid bone formation. Also that without oranges or some other food containing vitamin A, no amount of calcium stuffing is effective.

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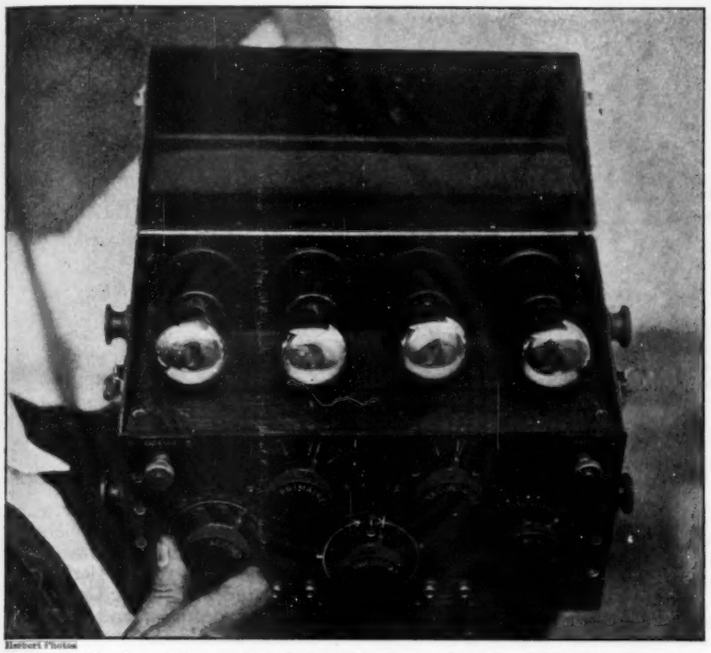
Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



Herbert Photos

This is the four-tube receiver designed to be used on René Fonck's ill-fated attempt to fly from New York to Paris

Dirigible Helps Radio Calibration

EXPERIMENTS conducted with the dirigible *Los Angeles* when flying along the Atlantic coast have shown that this type of aircraft is valuable as a means of calibrating radio compass stations. The dirigible is better adapted for the calibration of the radio direction finders than airplanes, according to the Navy Department, because it is steadier and can maintain flight for a greater period of time, at reduced speed if necessary. These factors increase the efficiency of the radio calibrations, which consist of checking the direction from which the radio waves come against an actual visual bearing of the compass station taken at the same instant. A series of the radio and visual bearings are plotted and from this data the error of the compass on every degree around the circle is computed.

The big airship conducts the calibration tests by flying around in circles within a 15-mile radius of the direction finder. The radio compass coil is at the center of the circle. The transmitter of the dirigible is operated continuously, sending a series of dots and dashes, while an observer at the compass station records the time of transmission and the bearing. Another observer is stationed close to the compass coil or antenna. This man takes the visual bearings of the airship and from the two sets of data obtained by these observers, curves are drawn which reveal any errors of the radio compass.

More Power for WLW

AN order for the first 50-kilowatt broadcasting equipment to be manufactured by the Western Electric Company has been placed by the Crosley Radio Corporation for use at station WLW, Cincinnati, Ohio. The management of the station reports that the transmitter and a new fireproof building in which it will be installed, will cost about 250,000 dollars. This installation will rank WLW among the most powerful broadcasters in the country. Two other 50-kilowatt sets are in operation at Bound Brook, New Jersey, and Schenectady, New York.

Radio in Spain

REPORTS from Spain indicate that the outstanding features necessary in radio sets in that country are selectivity and ability to tune-in distant stations. The Madrid station, the most powerful in Spain, is tuned to the 392-meter wave and London is on 365 meters, so a good criterion of a receiver is its ability to tune out Madrid and pick up London without any interference. Bournemouth is another transmitter close to Madrid's wave. It operates on 385 meters and it requires a good receiver to separate the two stations.

The Spanish sets use tubes manufactured in Spain and known as "Castilla" detectors and amplifiers. The Dutch make of Phillips tubes are also used in Spain.

Ninety-five percent of the radio apparatus used in Spain is imported from England, Germany and other sources, according to the Secretary of the Spanish Wireless Association.

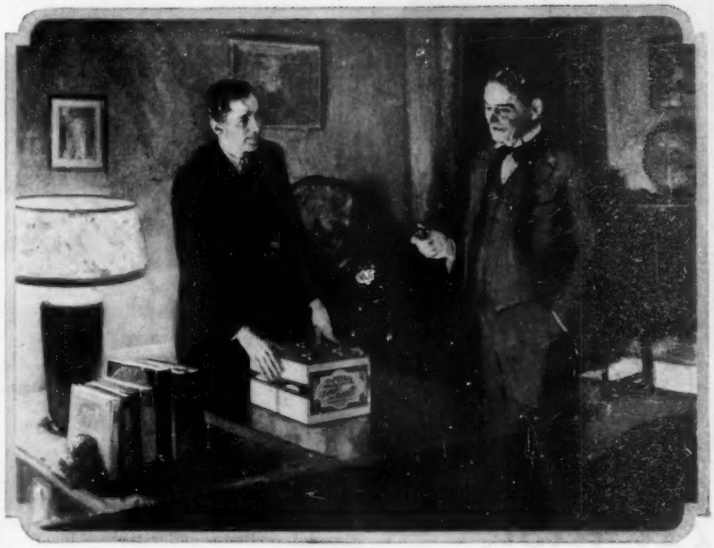
In developing a broadcasting system, Spain seems to be opposed to one built upon American, British or German lines and the popular slogans of radio fans are reported to be, "No monopoly," and "Freedom of Broadcasting."

New Project for Radio

THE British Broadcasting Company has formulated a plan, which has enlisted the interest of the Royal Colonial Institute, for inter-empire broadcasting of education and entertainment, through a chain of world-wide radio stations, which will reach an audience of 400,000,000 people.

According to Major Gladstone Murray of the British Broadcasting Company, the contemplated system would involve an expenditure of 3,000,000 dollars which could be raised by inducing all the constituent parts of the Empire to adopt the English system of paying for receiving licenses.

The powerful transmitter at Daventry, England, is mentioned as the starting point with Moncton, New Brunswick, 2,440 miles away as the first relay station. Other Canadian broadcasters, aided by land-wire re-



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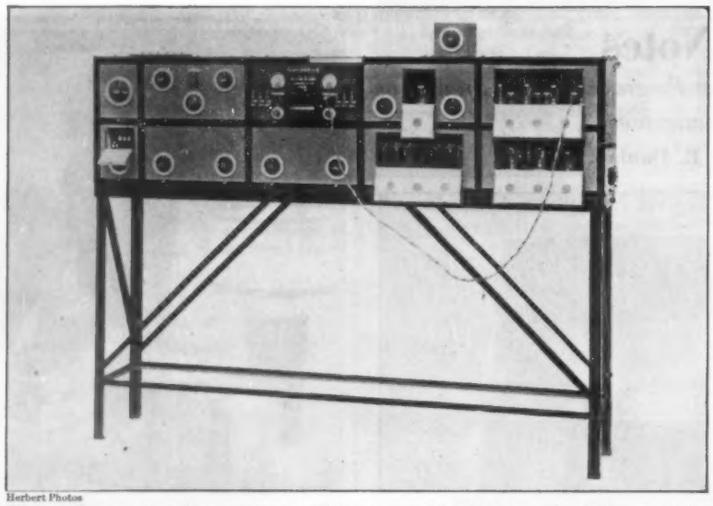


Herbert Photos

Marconi's new recording receiver. This set, used for high-speed wireless, is built in units. Top row from left to right: direction finder, tuning unit, control panel, oscillator generator and low-frequency filter. The lower row, left to right: search coil, two high-frequency filters, high-frequency amplifier and detector and direct-current bridge. Five models cover wavelengths from 450 to 50,000 meters

lays, would carry the programs across Canada and at the same time radiate them into space for Canadian listeners. At Vancouver the programs would be flashed to Australia, and from there to Colombo, Ceylon and Cape Town, South Africa. Colombo would be used to send the broadcasts to Bombay, India and Malta, thence back to Keston, England. Eight high-power stations would be involved in the project, as well as eight special receiving stations, six repeater stations and local broadcasting stations in the various countries.

For Greater Safety to Shipping

ELEVEN new radio beacons will be ready for service by June 30, 1927, to protect shipping along both coasts of the United States, the Gulf of Mexico and the Great Lakes, according to information given by the Department of Commerce to Dr. Frederick A. Kolster, inventor of the radio compass. The Kolster compass is used on ships in conjunction with radio beacon stations to give accurate bearings without depending upon visibility.

The United States Government is now operating 27 radio beacons, which is more than the total of all other foreign countries. Nine stations are in use along the Atlantic seaboard, nine on the Pacific coast, seven on the Great Lakes and two on the Gulf of Mexico. An additional score are awaiting the appropriation of funds.

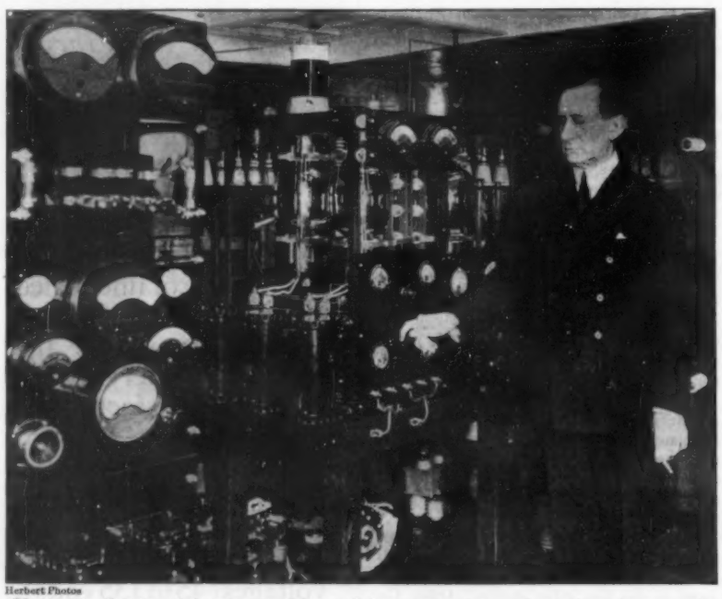
The beacons soon to be placed in service are the Stratford Shoals lighthouse, New York; Winter Quarter Shoals Lightship, Virginia; three in Florida on the Gulf coast; three in Michigan and one in Wisconsin for the Great Lakes and two along the Atlantic.

Approximately 300 American passenger and naval vessels are equipped with the radio compass and foreign ships are rapidly adopting the direction finders. The Kolster compass was first used on a passenger ship in 1922.

Radio Equipment for Press Club

A SPECIAL committee has been organized to plan and supervise the installation of radio equipment in the new 11-story, 10,000,000-dollar National Press Club Building at Washington, D. C. It is planned to "pipe" music and talks to various rooms throughout the structure so that press correspondents in the building may follow news events, such as a speech by the President of the United States, the proceedings of an important dinner, a dedication or other functions.

A radio central will be located in the club proper, which will occupy the two top floors, and from that point programs will be routed to loudspeakers or headphones in the main



Herbert Photos

Marconi's floating laboratory. The well-known inventor of wireless does much experimenting aboard his yacht *Eletra*

ASK . . ANY . . RADIO . . ENGINEER

The Crowning Adventure of Burgess Radio Batteries

They Flew Over the North Pole with Byrd

ON May 9, 1926, history was made—American history—World history—undying history.

Lieut. Commander Byrd, in his fearless 1500-mile flight across the top of the world, adds another thrilling triumph to the long, proud list of American achievements.

Radio went along, for radio has become vital to the lives and success of explorers and adventurers. Burgess Batteries went along, sharing the fate—sharing the hardships and the glory of Commander Byrd, the Detroit Artic Expedition, and Capt. Donald MacMillan.

It is eminently significant that in these glorious triumphs of American courage and American equipment where the test of men and their tools was the test of the survival of the fittest, that the standard products of the Burgess Battery Company were selected, used and "carried on" under extreme and unprecedented conditions.

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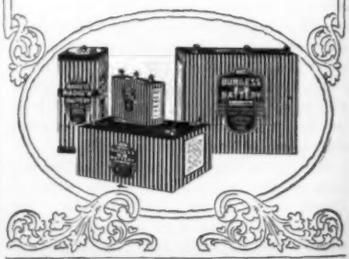

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USER-AGENTS WANTED Write for discounts

Herbert Photos

Utilizing the radio squeal. The "pianorad" consists of a keyboard of 26 keys, each of which, when pressed, causes a vacuum tube to oscillate at a desired pitch. The music is said to be clearer than the tones of a flute because there are no overtones. The instrument is installed at WRNY

club room, dining room or ladies' room. An experienced operator will be in charge of the equipment.

Facilities will be provided for microphone connections in case it is desired to broadcast notable events from the club.

Valuable Franchise

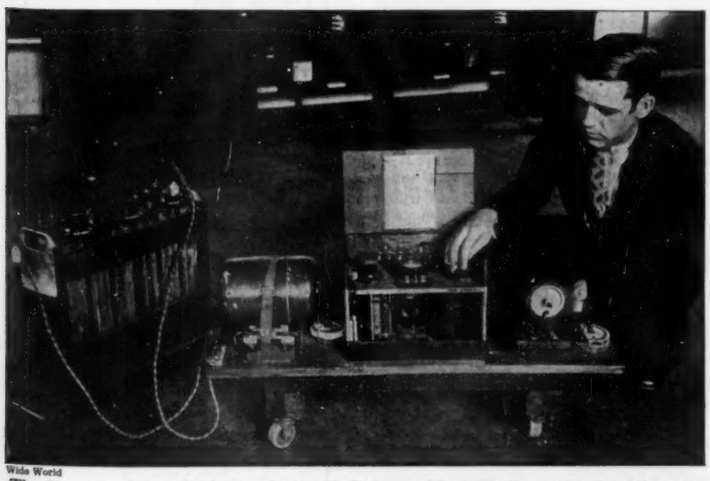
SAMUEL PICKARD, chief of the radio service of the United States Department of Agriculture, after a 10,000-mile tour covering the eastern half of the country, during which time he visited many broadcasting stations, said that he believed every college with a radiophone transmitter and a good wavelength has a million-dollar franchise.

Mr. Pickard said that he lamented the fact that many institutions are putting less money, thought and talent into their college stations than they merit. He pointed out that in this new endeavor, the college is in competition with broadcasters spending large sums of money for talent, and that if the agricultural agencies expect to compete for their share of the "countless millions," they dare not bore the radio audience with mediocre programs. He said that for effective extension work, the programs must be directed away from academic lectures toward the dramatization of facts.

Revising a Formula

TESTS are being conducted by the radio division of the Bureau of Standards in an attempt to revise the constants of the Austin-Cohen transmission formula, which was evolved to measure the electric field produced by radio signals over long distances. The experiments are being made with the hope of obtaining more correct values from the application of the formula under present conditions and at greater distances.

Observations made in recent years reveal that the formula worked out several years ago gives too low values for signal strength. There are difficulties attending the experiments because of the many disagreements in the measurements of different observers, especially at distant points where the signals are feeble.



Wide World

The Bureau of Standards has designed this portable radio beacon for calibrating direction finders on board ships. It is a miniature broadcasting station that can be transported to place to place

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Courtesy Radio Corporation of America

Ease of tuning and ample volume of reproduced voice and music are the outstanding features of this type of radio receiving set. The centralized tuning controls now so popular are located in the center of the panel. The loudspeaker is of the cone type and is shown on the small table to the immediate left of the set

Die-cast Condenser

A CONDENSER of new design, made by the die-cast method, with rotor and stator blocks built as two complete sections forming the main structure, has been introduced by the Unicontrol Condenser Corporation.

An accurate and smooth surface is obtained by the use of an alloy of aluminum, copper and silicon. The straight-line frequency effect is made possible through tapered circular segments without the usual offset plates, which are generally used by other manufacturers to gain the same result. The complete condenser consists of 12 parts, the bulk of which are about one-half of other condensers of the same capacity. The interleaving plates rotate parallel to the axis of the condenser.

The shaft is of novel construction and cone bearings have been substituted for the cylindrical bearings usually used in variable condensers. One of the bearings is of the semi-floating type, held under spring tension to compensate for any wear on the bearings. The engineer who designed the instrument points out that the main advantages of the condenser are durability, and no "end play" or "side play" when the dial is turned, no matter how long the device is in service.

Broadcasting Maps

TESTS being made at the United States naval radio station NAA, at Arlington, Virginia, indicate that ere long weather maps will be transmitted by radio to ships at sea. The weather charts furnished by the Weather Bureau are radiated into space in much the same way that radio photographs are broadcast. At the receiving stations, an ink stylus operating in connection with a cylindrical drum traces the lines of the map on a blank sheet of paper and the completed picture shows the isobars, barometric highs and lows and other information that is generally found on weather maps.

The system is the invention of C. Francis Jenkins of Washington who is noted for his experiments with radio motion pictures and television.

Those conducting recent tests explained that, to receive the charts, ships must be equipped with radio-map receiving instruments. Lack of dark-room facilities on board vessels, necessary for radio-photography, is the reason why the pen and ink stylus process is used for broadcasting maps to sailors, according to the experts at Arlington.

It now requires about 45 minutes to transmit a complete map but it is expected that the perfection of the process will reduce the time required to about 15 minutes.

Automatic Control of Transmitter

To avert interruption of program service resulting from break-downs in the apparatus, the automatic operation of a radio transmitter has been developed by engineers at station WGY, Schenectady, New York. An ingenious system of 15 relays, operated over three lines between the control room and the transmitter, govern the apparatus which is a quarter of a mile distant. There are also interlocking relays which automatically control the flow of water used for cooling the high-power tubes.

A Mobile Tester

S. W. EDWARDS, radio supervisor at Detroit, has an automobile equipped with a Kolster radio direction finder and testing devices which enable him to take bearings and locate stations operating contrary to government regulations. The car has already covered 15,000 miles and has saved more than $1,500 in railroad fare, according to Mr. Edwards. The car cost $4,500.

9DOZ Awarded Medal

C. B. HARRISON, owner of amateur station 9DOZ at Belleville, Illinois, has been awarded the Popular Radio medal for conspicuous service where "prompt and efficient action is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life."

Operator Harrison sent out an SOS call when a tornado wiped out Murphysboro, Illinois, and surrounding territory in March, 1925. As the result of the broadcasts from 9DOZ, relief was rushed from Chicago to the stricken area.

Great White Fleet

HAVANA

"Paris of the West." An irresistible, quaint old Spanish city where churches and forts, centuries old, form a background for modern shops that intrigue tourists. Palatial hotels — providing every comfort for the traveler — yachting, racing, sports of all kinds, make Havana an ideal winter resort.

JAMAICA

"Loveliest isle of the tropics." 3,000 miles of fine motor roads provide easy access to its beauties. Palms, spice trees, feathery bamboos, giant ferns, grow luxuriantly, and rare fruits and flowers make the island a fairyland. Two fine hotels, the Myrtle Bank and Titchfield are ready welcome to visitors from the North.

GUATEMALA

"Home of a vanished race." Here the Mayans built up an ancient civilization. Temples, monoliths of record indicate a high degree of advancement. Guatemala City, Antigua, the ports of British Honduras and Spanish Honduras are colorful, and of interest to tourists from the North.

PANAMA CANAL

"Eighth wonder of the world." Here the trade routes of East and West meet and ships of the seven seas traverse a waterway made possible by the skill and energy of America can engineers. Gigantic locks, dams and power houses against the tropic background are a revelation to visitors.

COSTA RICA

The railroad trip from Port Limon to the Capital, San Jose, is an adventure. Through tropical forests a height of over 5,000 feet is reached at Cartago, and the traveler passes from the tropics into the middle temperate zone. San Jose is a delightful city, thoroughly Spanish in atmosphere, and a warm welcome awaits the traveler.

COLOMBIAN PORTS

The cities of Santa Marta, Cartagena and Barranquilla are all reached by Great White Fleet ships. Massive fortifications and quaint, ancient sea walls still remain as mute evidences of the days when Spain dominated the New World. Emeralds, gold, oil, platinum, coal, are all found in abundance in this Republic.

Twice every week throughout the year, Ships of the Great White Fleet sail from New York and New Orleans on Cruises to the enchanted lands of the Caribbean. You can plan on a trip lasting from 11 to 24 days. And on every day of your Cruise you will enjoy excellent food, luxurious beds and that fine personal service which makes *"every passenger a guest."* . . . and, of particular interest — all shore trips, hotel accommodation, railway journeys, motor and launch excursions are arranged in advance for your pleasure and comfort — and *everything is included in the price you pay for your ticket.* Write for beautifully illustrated booklet and folders to

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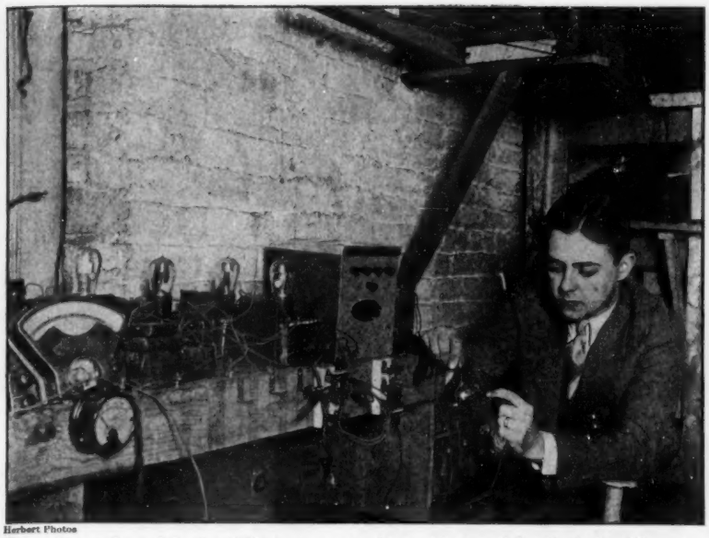


Herbert Photos

Experimental model of a "B" battery eliminator designed by Rutledge Mayo to supply voltage to the receiver from 110-volt alternating-current mains

Line-o-Light Tuner

A NEW model receiver, known as the Amborada, consisting of a seven-tube circuit, completely shielded and encased in a walnut cabinet has been introduced by the American Bosch Magneto Company. Above and in the top of the table surface, is a flush window through which the new "Line-o-Light" tuning system is viewed. A translucent drum-type scale is calibrated in wavelengths and from the under surface of the drum, a sharp line of light is thrown across the scale, lighting the exact wavelength to which the receiver is tuned.

Five condensers, each tuning a unit in the radio-frequency amplifier, are mounted with their shafts end to end. The coupling between the condensers allows for minute differences in shaft alignment and counter balances facilitate tuning the condensers.

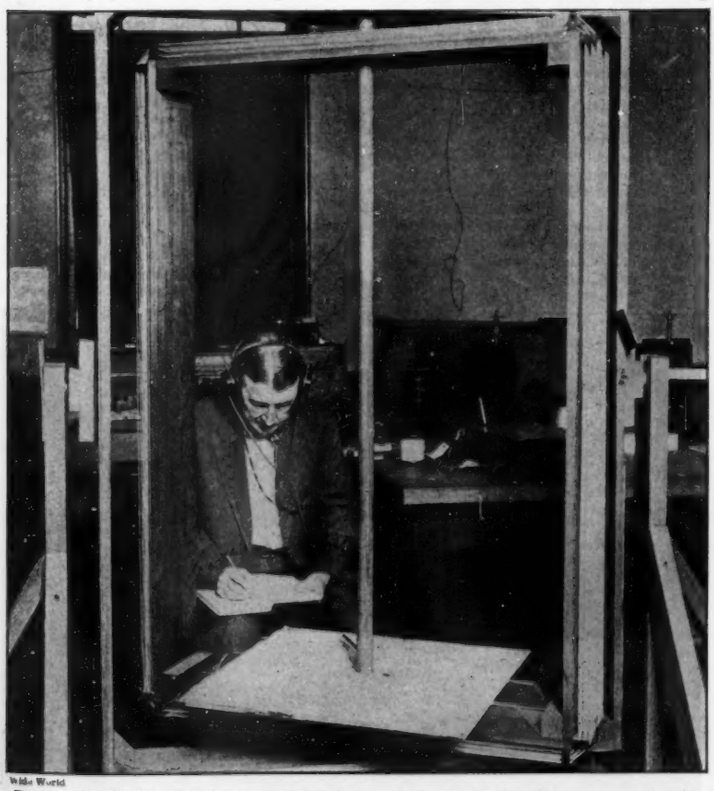
Space is provided in the lower part of the cabinet for all power accessories, including "A" battery, power unit and charger.

Short Wave Tests

THE Naval Radio Research Laboratory at Anacostia, D. C., is cooperating with 40 stations scattered over a territory of 7,000 miles in making tests on the 25.6-meter wavelength. So far it has been found that the 25.6-meter signals are not audible in daylight within a 500-mile radius of the transmitter, but that the intensity is good in the zone between 700 and 1,200 miles, and that from 2,000 to 3,000 miles the waves seemed more uncertain than within the 2,000-mile region.

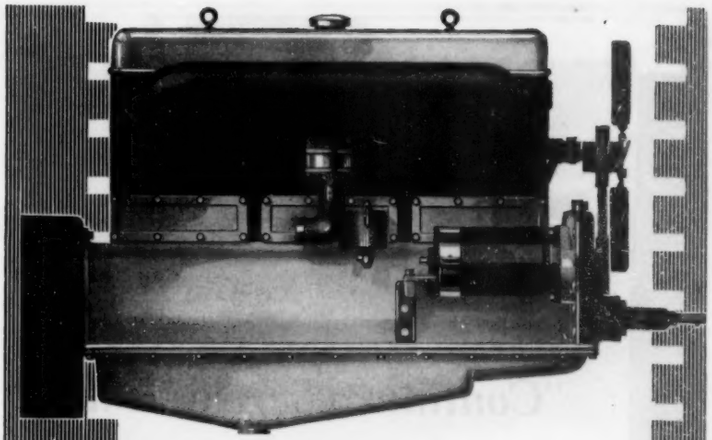
Colleges Organize

A COLLEGE and University Association of Broadcasters has been organized under the direction of C. A. Culver of Carlton College, Northfield, Minn., and J. C. Jensen of Nebraska Wesleyan University at University Place, Neb. The purpose of the organization is to safeguard and extend the educational features of radio broadcasting.



Wide World

Dr. Lewis W. Martin, chief of the laboratory for special radio transmission research of the Bureau of Standards, making observations with his double-axis receiving loop, which is used in the study of the direction changes of radio waves



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THE complete power range of Wisconsin Sixes and Fours, 20 to 120 H. P., affords important savings between factory costs and price-to-dealer.

For each of a full line of trucks, busses, tractors or construction machinery, Wisconsin provides the right motor. You do business with but one motor builder, capable of tremendous capacity, dependable, amply financed. Your inventory is always less, yet you are sure of a continuous flow of motors, scheduled to your needs.

In addition to factory-cost savings is the selling advantage of a definite demonstrable, economy in the performance of your product. Every model in the line Wisconsin delivers, invariably, more power per Cubic inch—more work per gallon of fuel and oil—and a consistently lower shop service.

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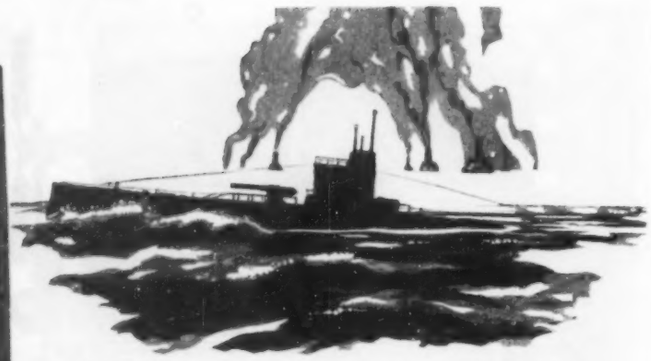

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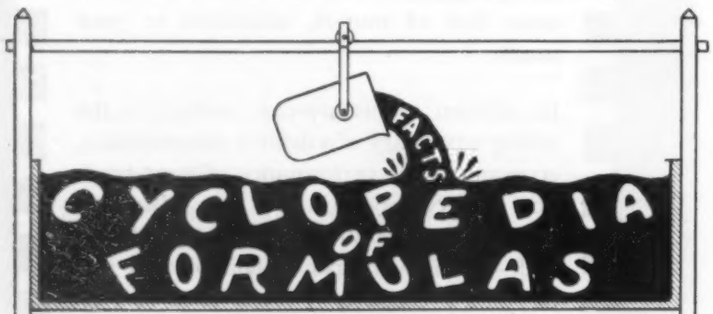

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A Reminder from the Past

Many parts of this country are rich in relics of Indian tribes that have long since passed to the "happy hunting grounds" leaving only a few scattered survivors to remind us of a race that once held sway over the entire United States. One of our readers has sent us some information on an old dug-out canoe, together with a photograph of it. We print the text of his letter below and the photograph will be found reproduced in these columns.

Editor, Scientific American:

The poet who wrote about "the upturned canoe on the lonely shore" and the memories it brought back to him would have been delighted to find the old canoe shown in the photograph, which, could it speak, would reveal many secrets of the time when its owner, some red-skinned aborigine, glided along the Muskegon River in pursuit of a deer he had driven into its waters, or perchance, on his way to the regular pow-wow at Maple Island twenty miles down the river.

The old canoe was found by three men who own land on the river front two miles below Newaygo, Michigan. They were digging a log out of the bank when they struck the canoe, and curiosity prompted them to continue digging until they had it uncovered. It measures 16 feet long, 19 inches wide, and seven inches deep on the inside. Made from Norway pine, it is very rough, being fashioned entirely with an axe, the deep marks of which are still visible. It is probably between seventy and eighty years old and is in almost perfect preservation, being still serviceable. A cave-in of the bank evidently covered it and the wet sand preserved it intact.

There is no doubt of its Indian origin. The place where it was found is the site of an old Indian village. Before the war of 1812, there was an Indian trading post on Muskegon Lake kept by a half-breed Frenchman. He made frequent trips up the river and the site where the canoe was found was a favorite camping place. Here there is a perfect horseshoe bend in the river. In the 40's a trading post was established and soon a large Indian village clustered around it. The habitations ranged all the way from bark tepees to log shacks.

When the lumbermen invaded the country, and began using the river to float logs, the Indian shacks on the flats had to be moved to the higher ground further back. Here the Indians lived for many years, trapping and making baskets which they sold in the lumber towns that sprang up near by. With the coming of the farmer, the trapping grounds became depleted and most of the Indians moved farther north. A few of their old shacks still remain, but of the large Indian population only three families are left. When the last of these shall have passed away, the old canoe will remain for the future generations of white people to meditate upon as a memento of a vanished race.

Harry L. Spooner,
Detroit, Michigan.

More on the 5-5-3 Controversy

We want accuracy first, last and always, and thank Mr. McMichael for his letter which arrived in the midst of the battle over the 5-5-3 controversy.

Editor, Scientific American:

In the recent article on the 5-5-3 controversy, by Capt. Dudley W. Knox, there are several inaccuracies which I cannot pass without mentioning.

Capt. Knox states that the British have only four coal-burning battleships. They have nine, viz.: *Thunderer, King George V, Ajax, Centurion, Tiger (B. C.), Iron Duke, Marlborough, Benbow* and *Emperor of India*, the first four of which will be replaced by the *Nelson* and the *Rodney*, oil-burners. Capt. Knox correctly states that the six Amer-

Reminiscent of the days when the Indian roamed the plains and hills of this broad country is the dug-out canoe illustrated above

This fine photograph of lightning flashes was submitted by one of our readers. The vertical flashes traveled upward, not downward

ican ships carry less reserve oil, but then they have a greater normal coal supply than corresponding British units.

Now as to the matter of bulges. Special appliances would have to be used to shift the oil or water quickly, and that would have to be done long in advance, as at present the oil could not be shifted from one tank to another fast enough to meet a sudden emergency in battle, and to add these appliances in advance would be contrary to the spirit of the Washington Conference, by which the maximum elevation of the guns was understood to be settled. Even if fitted, it would not be a very great advantage, as speed would be lost, and speed is everything in a modern action. Very likely a large quantity of ship's oil would have to be pumped overboard in this operation.

Capt. Knox first counts the "Queen Elizabeths" as blistered ships (because they will be in the near future), then later credits them with a superior speed, viz.:

"The nine fast British ships,". . . .

Four he means, of course, to be the battle cruisers, and the other five I presume, he means to be the "Queen Elizabeths." If fitted with bulges, their speed would not be materially greater than the other battleships, and would hardly be used in conjunction with the battle cruisers. Except for the four battle cruisers, the British ships have, or will have, about the same speed as the American ships.

The American battleships as a whole are newer, and better protected, so that if the six oldest have certain faults, I think they are more than made up for in the other ships.

Hoping to see more on this subject in your excellent magazine, I remain,

Yours very truly,
R. C. McMichael.

Mistaken

In our May issue, page 326, we stated that Mr. J. C. Vredenburg was one of the inventors of Pollopas, a new organic glass which may be bent. The following communication has been received from Mr. Vredenburg:

Scientific American:

Gentlemen:

I was today shown a small article in your May issue in which my name was given as joint inventor with Dr. Fritz Pollak of Vienna of a glass substitute that will bend. I do not know whence this information emanates, but would like to point out that your mention of myself as co-inventor is not correct, the inventors being Dr. Fritz Pollak and Dr. Kurt Ripper, both of Vienna. My own interest in the proposition is that of the inventor's financial representative.

J. C. Vredenburg.

Lightning Strikes Up!

Most people, if asked to express an opinion as to the direction in which lightning travels, would answer that it goes from the cloud to the ground. In some cases, they would be right but it so happens that often the direction of flow is from the ground to the cloud. The following letter draws attention to this fact and the writer of it was kind enough to forward a photograph of a lightning storm. Because it is a good one and interesting, we reproduce it in these columns.

Editor, Scientific American:

The article on page 133 of your August number reminded me very much of the storms we get in this part of the country and of the damage they sometimes do.

Here is a picture taken of a lightning storm that passed by Frederick, Oklahoma. The exposure was for six minutes. The vertical flashes in the center of the picture traveled from the ground to the cloud, not downward as is the direction in which most people believe lightning always travels.

Although the surrounding country was bombarded with many lightning, hail, and rain and wind storms during the month of July, Frederick got but a few sprinkles, all of the storms going around as shown in this photograph.

Douglas W. Young.
Oklahoma City, Oklahoma.

About Road Corrugation

The cause of road corrugation bids fair to assume the proportions of a large-size controversy. The opinions so far expressed differ from each other somewhat, and in all cases, facts are cited that at first glance appear to be irrefutable. Possibly the crux of the whole matter lies in the fact that there is more than one cause for this annoying formation found on some of our roads. In some cases, with certain types of road surface, the constant action of automobile traffic may be the sole or a contributing cause. In other instances, the method of repairing the road surface may be at fault. In any event, several of our readers have studied the situation and two of the best letters received to date are reproduced below. Both of these parties are firm in their convictions that road corrugation can be traced directly to one source but in both cases, the reasons put forth are different. This is a question that seems to be of immediate interest to many of our readers and if a satisfactory solution can be reached, one more controversy will be settled. The first letter blames traffic for holes in the road but not for corrugation. This reader finds fault with the methods of road repair in general use but offers constructive criticism.

Editor, Scientific American:

I was very much interested to read the opinion of Mr. R. L. O'Neill, of Nogales, Arizona, as published in the September number, regarding the cause of the "wash-board" effect on gravel roads.

In Michigan we have many hundred miles of trunk-line highways of gravel construction, on which various forms of scrapers are used to maintain the surface. I have made some study of this system of maintenance in this region and my conclusions may be of interest as supplementing the opinions of Mr. O'Neill.

In wet weather much damage is done by the pounding of high speed traffic, due to the "unequal hardness" of the surface caused by the unavoidable variation in the quality of the gravel, but the holes thus formed are irregular, both in size and spacing. Some damage of this

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nature is also caused by the traffic in dry weather, but the "wash-board" effect is caused almost entirely by the scrapers and this is done in two ways. First, as Mr. O'Neill says, by the spring or chatter of the scraper blade and second by the fact that the angle of the scraper blade and the direction of travel are almost never changed. As, day after day, the scraper goes over the road in the same direction and with the blade at the same angle, small ridges are formed and as the wheels of the machine pass over these each trip, the blade is raised and lowered, digging the corrugations deeper until the "wash-board" can easily be seen and more easily felt, the ridges extending from the center of the road toward each gutter at the angle of the scraper blade. The regularity of these corrugations causes the terrible vibration which is so annoying to the motorist, and so destructive to his car.

This trouble can be easily avoided if the angle of the scraper blade is changed each trip and the direction of travel frequently changed, thus cutting off any ridges or "humps" instead of rising over them and making them larger. Also, a form of "planer" having two or more blades set at different angles will prevent the formation of these regularly spaced ridges.

Ross E. Hammond,
Olivet, Michigan.

The second letter on this interesting subject blames the traffic for the road corrugation. Here it is. Is Mr. Brodsky right or is the solution put forth by Mr. Hammond the correct one? More study may bring forth further facts.

Editor, Scientific American:

The question of road corrugation has been touched upon in your magazine and a correspondent from Arizona lays the blame on road scrapers. In his opinion the automobile has nothing to do with it.

However, the corrugations come before the road scraper is applied and appear again after the road has been used for some time by automobile traffic, so that, obviously, that traffic must be held to account for the deterioration of the road, though the methods of road building and repairing may be faulty and inadequate.

I have carefully noted the changes in the surface of some roads in my neighborhood which I use frequently and my observations show that regular corrugations appear most distinctly on light tarred roads with an excessively thick layer of tar, binding almost pulverized stone.

It is a well known fact that tar, or pitch, is semi-fluid and the formation of waves, or crests and depressions, in it under repeated impact in one direction is very similar to those made by a stone cast into the water of a quiet pool. The element of time bears a different relation to the effect of impact on tar, and the action of the wheels, after the initial crest has begun to form, is apt to change somewhat the similitude.

A single rut on a horizontal road will start a series of corrugations along the entire length thereof. Vibrations set up by the passing of trolley cars help considerably towards the formation of corrugations, as they keep the surface in a state of instability, loosening the foundation.

The action of brakes on hills is responsible for irregular corrugations due to the dragging effect on the surface tar. The tar is thus heaped up most pronouncedly just before street intersections on hills on the right side of the road going downwards, whereas on the other side, that is, the right side going up, the surface remains in good condition considerably longer but gradually develops corrugations of a regular character due to the even action of the steady pull of ascending wheels on the surface.

My observations tend to show that the worst damage is done to a road by the braking action of motor vehicles descending hills at considerable speed. This applies to *all kinds of surface*, and is independent of any method of construction or repair.

As far as tarred roads are concerned, a single rut at right angles to the direction of heavy traffic will soon distort

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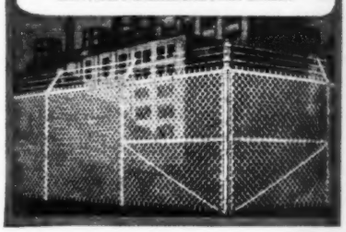

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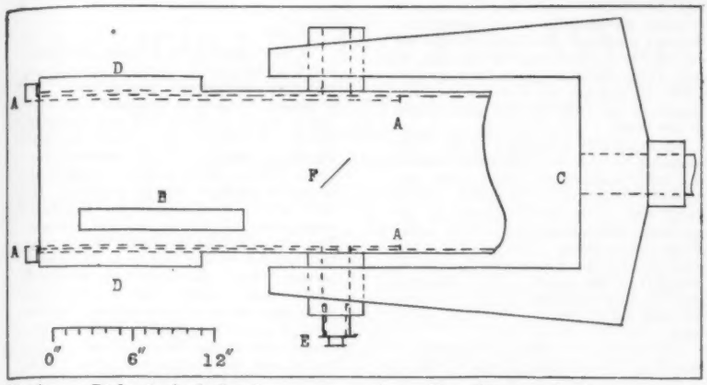

Professor Pickering's fork telescope mounting. For observers in the temperate zone, the diagram will be held diagonally

the whole surface, beginning at the rut and forming regular waves on a horizontal road. On a hill, the two sides will show distinctly different types of surface distortion as described above. Road scrapers have nothing to do with it, though they may be criticized as road building implements and found wanting.

G. Brodsky,
Worcester, Massachusetts.

Telescope

Down in the island of Jamaica, forty miles inland on an elevated plateau, Prof. William A. Pickering lives the year around in a home adjacent to his astronomical observatory, near Mandeville. From this vantage point only a few degrees from the equator he can see far more detail of Mars and the moon than most of us whose higher latitudes require the light from the planets to pass through many times more of the earth's disturbing atmosphere. Prof. Pickering has always been interested in the amateur astronomer, and now he contributes an interesting suggestion for a style of telescope mounting that conduces to comfort during observation.

Editor, Scientific American:

So many amateur astronomers are now constructing reflecting telescopes of the Newtonian type, that it is possible that some of them may be interested in a form of fork mounting that has recently occurred to me.

A prominent advantage of the fork is that we never have to reverse the telescope in the midst of an observation, when the object is crossing the meridian, as is necessary with the ordinary form of mounting. The very great inconvenience of the movable high seat, and the nuisance of the rotating tube, in the larger sizes of Newtonian telescope as ordinarily constructed, should certainly be avoided if possible. The former is particularly inconvenient if we wish to observe objects south of the zenith and near the meridian.

In order to avoid these objections, I sacrifice at once that portion of the heavens in the immediate vicinity of the pole—possibly all that portion north of declination + 60 degrees. This is about one-fifteenth of the whole heavens. This would cut me off from observing two out of the five well known stars in Cassiopeia. The northern pointer in Ursa major would also be eliminated. The constellations of Camelopardus, Ursa minor, a portion of Draco, and Cepheus would also be beyond my reach. But none of these are of any consequence, and I should leave them to other observers. I should then construct my mounting as indicated schematically in the accompanying figure.

The length of the telescope could be anything desired—as long as a refractor if convenient. I have drawn the tube 12 inches in diameter. The breadth of the casting of the fork at the end of the polar axle, C, is assumed to be six inches. It might perhaps be narrower. The distance from this point to the center of the flat, F, is 18 inches. The mirror is not shown, as it would be beyond the figure to the right. The light from it strikes the flat, and is reflected through the short declination axle to the eye-piece, E.

Either end of this axle can be used, and in order to do this the flat is supported by a tube A, A, A, A, which rotates within the telescope tube. A hole in these two tubes transmits the light from F. There is no need in this case of rotating the large mirror. One of the finders is shown at B. There should be another similar one on the other side of the fork. The counterpoise ring is shown at D, D.

The observer's height will not change greatly during the observation. Otherwise he will not move until the object crosses the meridian, when he will shift to the other side of the pier, carrying the eye piece with him, or using a duplicate one. For northern objects whose altitude does not exceed 30 degrees he will have to look upwards at an angle of 60 degrees or a little more, but this is not unusual to those accustomed to the use of a refractor. When the object crosses the meridian he will be looking horizontally.

For a long-focused reflector it is possible that a movable seat could be attached to the pier. With such a short

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fork the observer would find that objects crossing the meridian at an appreciable distance north of the zenith would be cut off for a short time by the pier itself. This could be partially remedied either by making the tines of the fork longer, or by using an iron pier curved to the north.

An incidental advantage of the fork mounting is that we can readily make the tube appreciably larger than the mirror. This, it is believed, would avoid some of the trouble caused by air currents circulating within the tube. With the ordinary form of mounting such an increase of size would add considerably to the expense. It is believed that the fork mounting could be manufactured more cheaply than the usual form.

W. A. Pickering.
Mandeville, B. W. I.

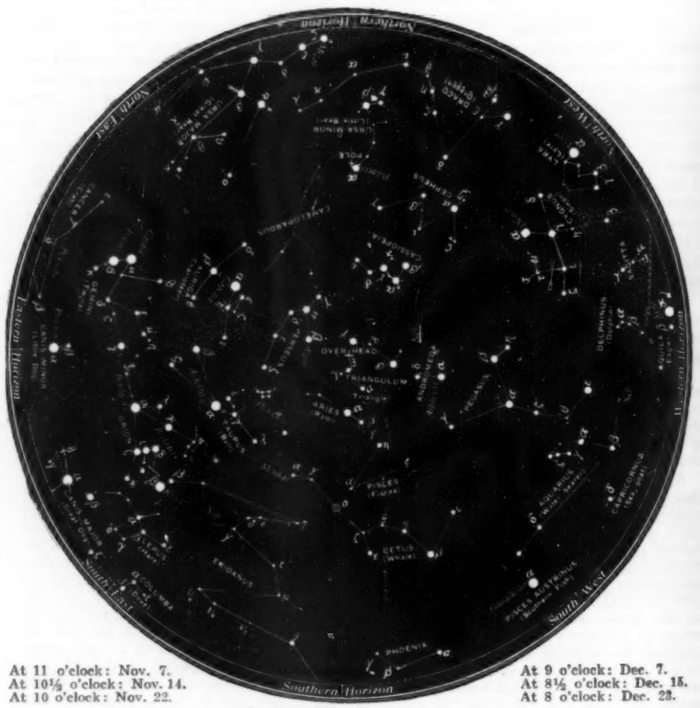
The First Postage Stamp

One of our correspondents who is an enthusiastic stamp collector sent us a photograph, which we reproduce on page 389, of the alleged first postage stamp which is interesting, not as a postage stamp at all but because it is a whole envelope. He writes as follows:

"It is a mistake to assume that this envelope was really the first attempt at using an indicator of prepayment. As a matter of fact a postpaid envelope was in use in Paris in 1693 and stamped postal letter-paper was issued by the Sardinian States, but it remained for Great Britain to inaugurate cheap and universal postage within a state. In 1839, prizes were offered for the best suggestions as to the use of stamps. The first prize was two hundreds pounds, the second prize was one hundred pounds. Two thousand seven hundred replies were received but no improvement was advanced over Rowland Hill's idea of a postage stamp. Both the envelopes and stamps were tried out by the public and the stamps won out. Each sheet of stamps carried this notice: "Place the label *above* the address and toward the right hand side of the letter. In wetting the back be careful not to remove the cement." The so-called "Mulready Envelope" soon passed out of existence and into the collector's album but the idea survives in stamped envelopes.

The Heavens in November

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.
At 9½ o'clock: November 30.
At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

NIGHT SKY: NOVEMBER AND DECEMBER

The Heavens

FROM the star map this month, it will be found that, at the hours mentioned below it, Perseus, Andromeda and Aries are almost overhead. Mars, which is in the last named constellation, is high in the southeast and recognizable at once by its great brightness and ruddy color.

The southern sky is dull but the east is splendid, showing Auriga, Taurus, Gemini, Orion and the two dog-stars low on the horizon. The two Bears and the Dragon are low in the north and Cassiopeia is high. Cygnus and Lyra are sinking in the northwest and Pegasus is high in the west. The brightest object in the southwest is the planet Jupiter now well toward setting.

The Planets

Mercury is an evening star before the 25th and a morning star afterward. He would be fairly well visible in the early part of the month if he were not so far south, but, as it is, he sets at 5:50 P.M.—although 23 degrees from the sun—and will be hard to see. Venus is still a morning star when the month begins, but comes into conjunction with the sun on the farther side on the 21st. At this time she comes very near to going behind the sun's disk, in fact, within six minutes of the northern limb, but unfortunately, she is invisible.

Mars is in opposition as has already been stated, and is visible all night. Jupiter is in the eastern quadrature on the 11th and comes as an evening star, remaining in sight until 11 P.M. Saturn is in conjunction with the sun on the 21st and is invisible but it is worthy of note that on this date, he is also in conjunction with Venus, both planets and the sun being included in a circle about two degrees in diameter. Uranus is in Pisces and comes to the meridian about 8 P.M.

The moon is new at 10 A.M. on the 5th, in her first quarter at 6 P.M. on the 12th, full at 11 A.M. on the 19th, and in her last quarter at 2 A.M. on the 27th. She is nearest the earth on the 16th and furthest away on the 28th. During the month, she is in conjunction with Venus on the 4th, Saturn on the 6th, Mercury on the 7th, Jupiter on the 12th, Uranus on the 15th, Mars on the 17th and Neptune on the 26th.

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

An Air Sleeper

THE German publication *Flugsport* describes the Albatros *L 73*, equipped with two 240 horsepower engines, in which the problem of providing an air sleeper has been seriously attempted. The passenger cabin is provided with every comfort. The cabin is 5¾ feet in height, five feet in width and 18 feet in length. There are eight seats placed along the walls of the cabin. In between the seats is a gangway which leads into the pilot's compartment at the forward end of the fuselage. The seats are comfortably upholstered and provided with adjustable backs. A few adjustments and the four seats on either side are converted into two bunks, so that four men in all can sleep comfortably in the cabin.

Under each seat there is space for passengers' hand baggage, with additional baggage accommodation in the overhead nets. Overhead lighting, large windows of triplex glass, warm air heated by the exhaust, and a convenient washroom in a separate part of the fuselage, complete the arrangements for passenger comfort.

It is interesting to see how the once cramped cockpit, open to every blast, is evolving into a regular Pullman sleeper. The only drawback to the air sleeper is the uneconomical prospect of carrying only four passengers with a horsepower of 480. Perhaps the airplane cabin will grow slightly higher and the double-decker familiar to every Pullman traveler will finally make its appearance.

Slotted Wings and Flaps

WINGS with slots at the leading edge, and slotted rear flaps are now being used in at least four machines in England and Germany. It is surprising that their use is not spreading even faster. In the trials of the Handley Page *Hendon*, a torpedo-carrying plane, equipped with these devices, some surprisingly slow-speed landings and glides on a steep path with the fuselage almost horizontal were recently made. The diagram reproduced from *Flight* illustrates the very latest method of employing the slot and flap for increasing lift and for improving the lateral control.

On the left of this diagram is shown the disposition of the device for getting off and landing. The front slot is open, the rear slotted flap is depressed. The lift coefficient of the wing is thereby increased between 75 and 100 percent over its normal maximum value. The landing speed can be reduced correspondingly, adding appreciably to the safety of the craft. On the right of the diagram, the end and center slots are closed, and the end and center flaps are held neutral; this is the best condition for fast, normal flight. In the center diagram the middle slot and flap are closed and neutral respectively, and the end slots and flaps used in a manner to make them most effective for control in normal flight.

The particular advantage of this device, besides increasing the lift and the power of the ailerons, lies in the fact that the ailerons continue to be effective when the wing is at a large angle of incidence beyond the "burble" or stalling point; conventional ailerons beyond the stall become ineffective and produce a dangerous tendency to turn the machine in a direction which does not correspond with the desired bank. We have dealt with this topic at length in previous issues of the Scientific American. The interest of this latest information lies in the special disposition of slot and flap now adopted. Evidently British designers have decided that the aileron control must be distinct from the lift-producing center slot and flap even at the expense of greater complexity.

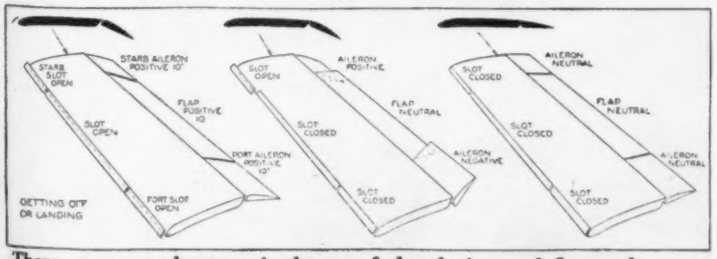
Brakes on Airplanes

BRAKING the wheels of an airplane shortens the landing run but tends to nose the plane over. Placing the center of gravity far behind the wheel axle eliminates nosing-over, but makes it difficult to raise the tail off the ground in making a get-away. The combination of front-wheel brakes and a third small wheel at the tail seems to have eliminated all difficulties. In the recent Detroit Reliability Tour many of the machines were equipped with brakes, and came to rest in 100 feet instead of the 400 or 500 feet customary hitherto. With brakes, it is no longer necessary to use ground tackle or to have men hanging on to the tips of the wings; the pilot puts his brakes on, opens his engine full and starts off with the ease of an automobile driver. If the brakes on either side are independently controlled it is possible to steer in taxying on the ground even when the air rudder is scarcely effective. Many different types of airplane brakes are now available. In the Douglas T-2, of the type used in the round-the-world flight, two large metal disks are used, one bolted to the outside of the wheel and the other mounted on the outer end of the axle in such a manner that it bears against the wheel disk when the brake pedal is depressed. The brake cams are actuated by flexible cables connected to the brake pedal. These cables pass through the hollow struts of the landing gear.

European Air Transport

AIR Vice-Marshal Sir Sefton Brancker has been, for several years, Director of Civil Aviation in the British Air Ministry. His lecture on Air Transport before the London Junior Institution of Engineers may therefore be regarded as an authoritative pronouncement.

No subsidies to air lines have ever been granted in the United States, nor are they likely to be granted. The "Air Commerce Act of 1926," which provides for the appointment of an Assistant Secretary in the Department of Commerce, will allow this Department to give navigational aids to air lines in the form of lighted airways, radio



There are many advantages in the use of slotted wings and flaps such as are diagrammatically shown above and described in the text

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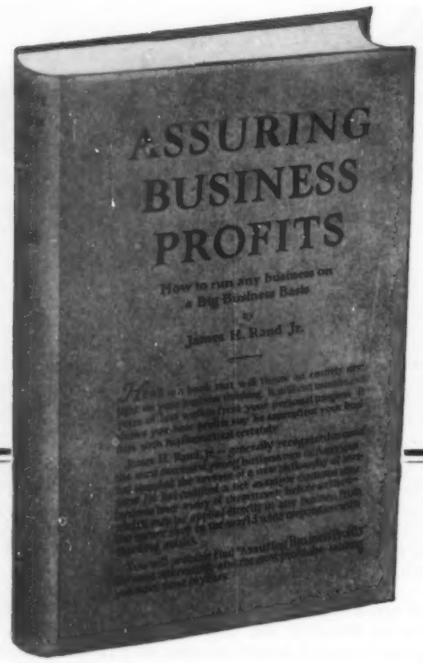

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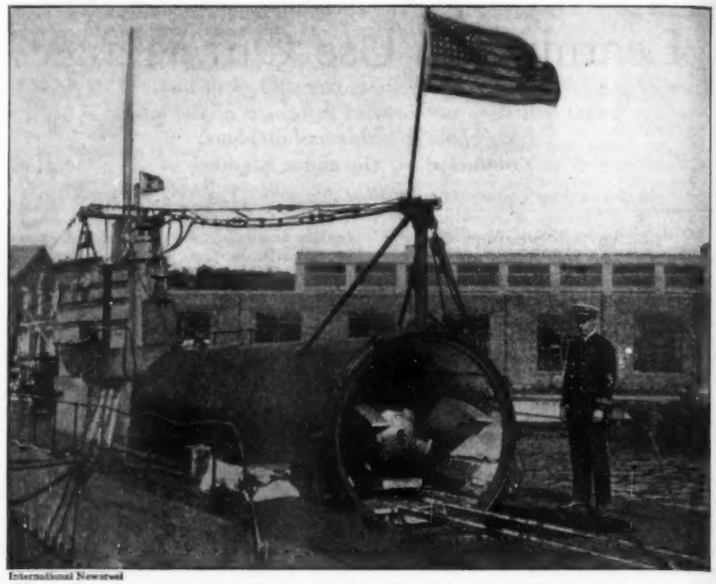


International Newsreel

The submarine plane stowed away in its tube, into which the various parts fit neatly. The tube is fixed to the top of the submarine deck

direction beacons, and by the transmission of weather reports. This indirect form of aid is accepted by almost all authorities as far more advisable than the European method of actually subsidizing air-line operators in cash.

As a result of subsidies, the British, French, German and other services make no extraordinary efforts to run at anything but a loss and Sir Sefton points out that only one air line in the world is paying its way, namely, the Scadta, up the Magdaléna River to Bogota, in Colombia. The subsidies paid or voted for in 1925 in England, France and Germany respectively were 137,000 pounds, 57,210,000 francs and 6,700,000 gold marks, and it is evident that these cannot be continued indefinitely.

The Air-Marshal states that the present total cost of carriage by air is about 5 shillings or say $1.25 per ton-mile at 90 miles per hour. This is a figure of about the same order of magnitude as that of the closest American estimates. In his opinion, such a charge is high but not too high for passenger traffic, is low enough to attract first-class mail matter, but is too high to attract any great volume of freight. Undoubtedly this would apply in America also.

Airplanes are frequently regarded as fragile craft of short life. On the Imperial Airway from London to the Continent, machines show an average of 1,000 flying hours per year, and are useful for several years.

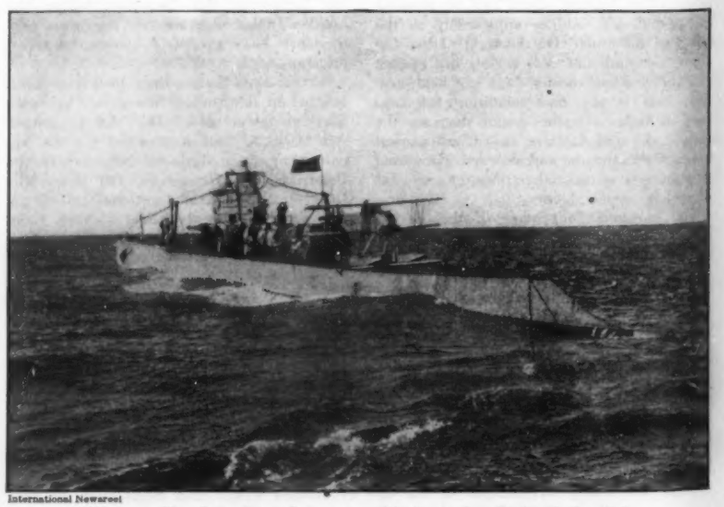
Airplanes were once regarded as a very bad insurance risk, with premiums running as high or higher than 20 percent. Now they have fallen to 7½ percent for three-engine-ships, with only slightly higher rates for the single-engined types.

The ultimate success of air traffic depends on public confidence. Statistics given by Sir Sefton are most encouraging. Taking the period from May 1919 to December 1925, the mileage flown in recognized British transport service was 4,431,000. There were four fatal accidents in which 13 passengers were killed and five injured. There were no fatal accidents at all in 1925. With the use of multi-engined planes, various devices to reduce the stalling speed, and with better methods of navigation, the danger of accident is beginning to be regarded by British authorities as almost negligible.

A Submarine Plane

A SUBMARINE scouting for an enemy has neither great speed, nor a long range of vision, whether submerged and sighting through a periscope or floating on the surface but without the aid of mast or conning tower. Accordingly, the United States Navy has for several years sought to develop a submarine plane and to devise methods for stowing it on board.

In the design of the plane, the problem was to produce a craft small enough to be packed in a tube not more than five feet in diameter, yet thoroughly airworthy. Cooperation between the Navy Bureau of Aeronautics and the Glenn L. Martin Company has resulted in the production of the small seaplane shown in the first of our photographs. The seaplane has a cockpit just big enough to shelter a pilot who is not of excessive proportions. Its engine is a light



International Newsreel

The small submarine plane assembled on the deck of the *S-1*

three-cylinder Wright air-cooled type. The spread of the wings is approximately 20 feet, and the overall length is proportionately small. To facilitate assembly and disassembly, the plane, although it is a biplane (a monoplane would have a larger span and would therefore be less suitable), has no bracing wires requiring careful adjustment; the wing truss consists entirely of struts acting as either tension or compression members. The truss is further simplified by the fact that the struts going from the outer point of the wings to the pontoons serve also to brace these pontoons. No guns are carried, the gasoline supply is sufficient only for two hours' flight, and by cutting out all non-essentials, the weight is kept a trifle under 1000 pounds when fully loaded. The loading per square foot of wing area is somewhat high, and this, with the low gross weight, keeps the wing area at a minimum. The little craft, though provided with only 60 horsepower, is capable of at least 80 miles an hour.

As a result of this careful design, the plane can be readily packed in the comparatively small tube shown. The fuselage occupies the center of this tube with the engine still mounted at its front end. The wings, in four parts, are slid into position at the periphery of the tube, and the pontoons are neatly wedged in between.

A few minutes suffice for disassembly; nine minutes for complete assembly. To make a get-away, the deck of the submarine is kept almost flush with the level of the sea. The plane moves under its own power on specially prepared ways and leaves the water just as any hydroplane. Hoisting the small plane on board again is not especially difficult since the deck may be kept as low as desired, whereas on a battle-ship, hoisting the plane aboard is quite a delicate operation.

An Airship Control Cabin

COMMANDER CHARLES E. ROSENDAHL was the senior surviving officer of the *Shenandoah* and is now commander of the *Los Angeles*. He is shown in the control cabin of the giant airship. Just a glance at the photograph is sufficient to indicate the complexity of airship piloting. In this work there are many more things to think of than in handling an airplane. The amount of water ballast must be watched if longitudinal balance is to be maintained, and a special chart for this purpose appears in the control cabin.

As the *Los Angeles* burns up fuel, it becomes lighter, shoots up high into the air and must lose valuable helium to descend unless the water recovered from the engine exhaust gases is sufficient to compensate for the loss of fuel weight. Hence the lines labelled "Fuel" and "Water Recovered" figure prominently on the board. Each compartment of the airship needs watching as regards gas pressure and content, hence the gas control connections in the upper right corner of the picture. All this, in addition to the engine controls, actual steering, study of weather conditions, et cetera, make the control cabin of an airship a very busy place.

Wide World

Commander Charles E. Rosendahl in the control cabin of the *Los Angeles*. Note the charts on the wall, and the control cords above them

Maintenance of Airplanes and Engines

THE scientific aspects of aeronautics have been given intensive study in many laboratories both in the United States and in Europe. But, little systematic attention has been given to problems of maintenance and depreciation. However, reading Lieutenant E. W. Dichman's paper in the *A.S.M.E. Journal* (American Society of Mechanical Engineers) is a revelation as to the work done by the Army Air Service in this direction.

In military flying a few forced landings due to engine trouble may be excusable, but in commercial operation, engines *must not fail*. There are now far more reliable engines in use than the Liberty motor, but from consideration of expense, the Liberty, as it is surplus war material, will be used for many years to come. How much service is then to be expected from the Liberty? According to air service practice, 150 hours. Then there must be a complete overhaul, which in man-hours must be given 175 units. This must include a complete overhaul, teardown, cleaning of parts, inspection, grinding of valves, assembly and timing. With such care, the life of the Liberty may be as much as 500 hours.

Airplanes may run as long as 250 hours between overhaul (and this means some 200,000 or more miles of flight). With a periodic overhaul of 200 man-hour units,

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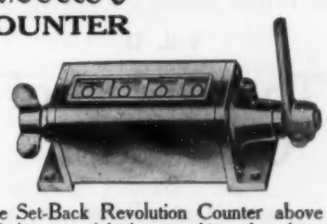
The large Set-Back Revolution Counter at right is less than ¾ actual size. The small Revolution Counter below is shown nearly full size.



The Set-Back Revolution Counter above records the output of the larger machines where the revolutions of a shaft record operations or output. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price, with four figures, as illustrated, $10.00 (subject to discount).

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Front view of the Ireland *Meteor*, a neat and inexpensive plane suitable for general aerial service and private ownership

according to Lieutenant Dichman, the life of an airplane may actually be 2,000 hours before salvage becomes imperative. The overhaul consists of removing the fabric from wings, fuselage and tail surfaces, inspecting all fittings, spars, and the internal structure generally, and of re-assembly with the utmost care in lining up.

Even the life of the present type of plane and engine becomes satisfactory from a commercial point of view, if maintenance and inspection are given due care.

A Useful Plane

WHILE public attention is largely concentrated on the large airliners of the type built by the Fokker and Ford companies, the plane suitable for individual ownership is selling in fairly large quantities. One mid-western company reports a production of a plane a day. The Ireland *Meteor* built at Garden City is an excellent example of the small, inexpensive plane, suitable for general aerial service work and for the private owner. Our two photographs show its many desirable characteristics. A thin-bladed Curtiss-Reid duralumin propeller is employed which has both a greater efficiency and a greater durability than the wooden propeller. The engine is the well tried OX-5, an eight cylinder water-cooled type, of comparatively low fuel consumption, with which the plane manages to carry a pilot and three passengers at a maximum speed of well over 90 miles an hour. The spinner and cowling give a very streamline appearance to the front of the fuselage. The pilot and front passenger have particularly good vision. The landing gear is of the no-axle type, reducing the effect of obstructions on landing. Rubber compression rings are used instead of shock absorber cord, thus obviating much tiresome winding and replacement of cords. The tail skid is steered from the rudder pedals, giving complete directional control of the plane while taxying on the ground. An interesting detail is the control stick which is located between the pilot's feet and curves back over his knees so that there is no need for spreading them apart to operate the ailerons.

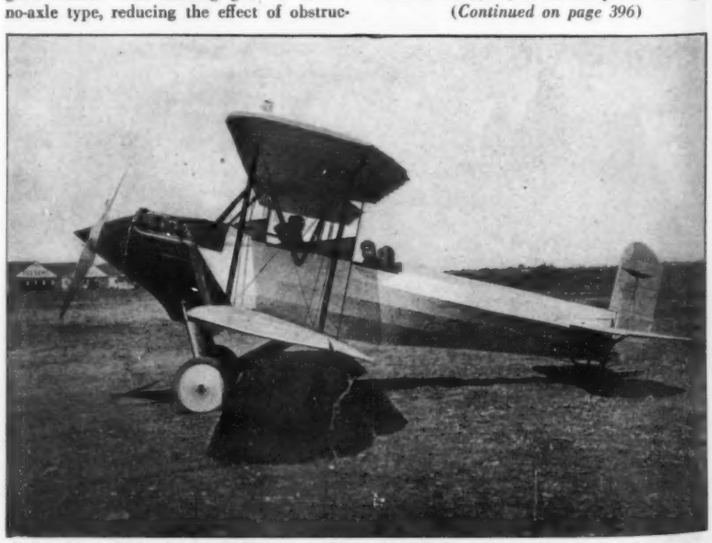
Flying at Night

WESLEY L. SMITH is one of the most skillful and experienced pilots flying for the Air Mail Service. In a recent paper read before the Society of Automotive Engineers, he ended with this remark: "If any of you are slightly bored with life and crave a little excitement, just hop into a plane some dark and stormy night and try to fly to Cleveland from New York." His paper was conclusive evidence both of the difficulties of night flying and of the care and ingenuity which has made it possible.

The country from New York to Bellefonte, Pennsylvania, is a series of valleys and mountain ranges; from Bellefonte to Cleveland, it rises at once to a plateau, with narrow river gorges and low mountain ridges, sloping down gradually to Cleveland. On the whole it is difficult territory and the weather is often uncertain and dangerous. If night flying is possible between New York and Cleveland, it will be possible almost anywhere in the United States.

Emergency fields are placed at 17-mile intervals. The distance between the giant beacons of 2,000,000 candle-power is eight

(*Continued on page 396*)



Side view of the Ireland *Meteor*. With an OX-5 engine, this little plane can carry a pilot and three passengers at 90 miles per hour

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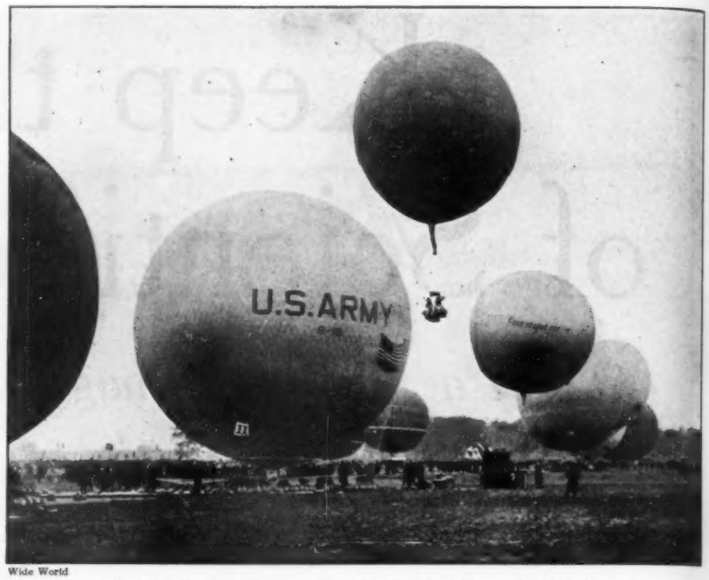

Wide World

In the race for the Gordon Bennett Trophy, held at Brussels, Belgium, American balloons took first and second places. Ward T. Van Orman and Walter W. Horgan won the trophy after covering 528 miles in the *Goodyear III*. The United States Army balloon, *S-16* won second place. The start of the race, with the *S-16* in the center on the ground, is shown above

miles, on an average. Each terminal and emergency field is bounded by lights about 250 feet apart. At the terminal fields all obstacles are surmounted by red lights, and the best approaches indicated by green boundary markers. The lights of cities and towns, large factories, blast furnaces and the like are great aids to a pilot who knows the route. But thick weather may obscure both the beacons and the "natural" lights to a great extent.

Even in fairly clear weather, emergency night landings are hazardous. Great care has been expended on lighting the plane itself. The special night equipment comprises three navigation lights, one on each wing-tip and one on the tail to enable pilots to see other ships *en route;* two large headlights on the order of automobile headlights, but much more powerful are used in emergency fields which have no flood-lights; and two magnesium parachute flares are carried, which at an altitude of 2,000 feet will light a square mile of territory brilliantly.

But even all these lighting aids are not sufficient; instruments must be carried which will enable the pilot to fly straight although nothing outside of the ship be visible.

There is first the compass, which on board aircraft has reached a high degree of refinement. But the compass is a poor guide in storms, because when the ship oscillates in rough weather, the compass needle comes under the influence of the vertical component of the earth's magnetic field and swings about erratically. Therefore the compass is supplemented by a turn indicator, which is based on the ability of an air-driven gyroscope to keep a direction always parallel to its original one. Pilots who have to rely on their senses alone in fog, lose their perception not only of direction but also of balance. Hence a bank indicator, or lateral inclinometer is carried which consists of a steel ball in a slightly larger curved glass tube filled with alcohol to dampen mechanical vibrations.

Flying by instruments alone is an intense physical and mental strain on the pilot. The plane itself should be stable fore and aft, laterally and directionally. It should be one that is capable of being flown "hands off," whether flying level, climbing, or descending in fairly rough weather. Modern mail planes are beginning to approximate these requirements. Further, the craft must be extremely maneuverable for getting in and out of poor emergency fields, it must have a slow landing speed because emergency fields are small, and it must have a rapid climb to clear obstacles on a take-off or clouds whose moisture may freeze on the ship. Besides 1000 pounds of mail, and fuel enough for a non-stop flight against a head wind of 30 miles an hour, there must be at least an hour's emergency fuel supply on board to guard against the possibility of losing the way in bad weather.

Reports of the much maligned Weather Bureau are indispensable. The weather stations give the pilot the type of weather, ceiling, visibility, wind direction, temperature and barometric pressure. The ceiling, as it is aptly called, is the height of the clouds above the ground, measured by projecting a spot light at an angle of 45 degrees and by pacing the distance from the light to the point directly under where the beam hits the clouds. From the weather maps, a skilled navigator can nearly always tell what awaits him ahead. Now that radio communication between plane and ground is available, the utility of these weather reports is further enhanced.

Thunderstorms are very hard on the flier. When the temperature ranges around the freezing point, moisture in the clouds will freeze onto the plane, first upon the wires increasing them, with the ice coating, to three times normal size, then upon the struts and fabric, loading the plane, increasing its resistance to the air stream and finally bringing it down at landing speeds 20 to 30 miles higher than normal. But the very worst enemy is fog. The visibility of the most powerful beacons disappears. It is then that reliable instruments and courage are really needed.

The Air Mail Service has done a wonderful piece of work in making night flying possible. But it is quite evident that there remains for the Department of Commerce, now taking over the provision of navigational aids to flying, a really difficult task and one which will involve the improvement of airway lighting, the improvement of weather reporting, the use of radio direction beacons and the provision of many other devices which will tax the energies of its engineers.

An Engine Heater

AIRPLANES in ordinary winter service are often placed in unheated hangars. Under such conditions it is either necessary to drain the water from the engine, or to keep the engine warm enough to prevent the water from freezing. The *N. A. A. Review* describes a simple device which overcomes this difficulty. This is the Mayall heater, consisting of a short brass tube about eight inches long, surrounded by electric heating elements. The brass tube is inserted in the water line near the engine, thus setting up a circulation of warm water in the system. For 60 cents, 16 hours of heating can be secured, and all freezing difficulties avoided.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

IF there is one thing the inventor will not tolerate, it is to have anyone say, "It can't be done." More power to the inventor for that attitude! It is the attitude that has overcome all the obstacles in the way of progress; it is the attitude necessary for success in invention as well as in any other field of endeavor.

However, there is a limit to the things an inventor should try to do—perpetual motion for example. Scientists generally agree that perpetual motion is impossible. The Patent Office agrees with the scientists and imposes extra restrictions upon the inventor who claims to have solved the problem.

Nevertheless, perpetual motion does seem to have a fascination for inventors. Only last week a very earnest man tried to induce us to apply for a patent for him on a device which would run without stopping. There have been hundreds of such efforts in our offices alone in the eighty years that we have been aiding inventors. It is not likely that you can solve the problem of perpetual motion. At any rate, your time and ability can be spent to far better advantage in seeking to answer one of the many other needs of modern civilization. *Don't bother with perpetual motion.*

"The Perfection of Imitation"

THE invention which the court has called "the perfection of imitation," the embossing process of the Simplex Sampling Association, whereby illustrations in advertising look like an actual piece of cloth pinned to the paper, has won a substantial victory in an infringement suit against the John C. Powers Company.

The patent relates to cards for displaying textile samples. Instead of the actual textile being used, a raised panel is formed by an embossing process and the texture and fabric is reproduced in color.

"The new product is the production of illusion," says Judge Hand, quoting a previous decision, "i.e., making the eye believe that actual pieces of cloth are in view."

The defendant's device sought to accomplish the same result by "making a panel raised above the base to a distance substantially less than the thickness of the fabric simulated, said panel having one edge inclined from the plane of the panel to the plane of the base." Nevertheless, the court holds, "The differences relied upon to secure immunity seem technical and trivial. A preliminary injunction is granted upon filing a bond."

Names from the Orient

THE novel argument that trademarks deceive the public if they suggest the same scenes, traditions or historical events that other marks do, was made in vain by the Egyptian Lacquer Manufacturing Company in its recent patent opposition to registry of the word "Pharaoh" as a trademark for lacquers. The opposer uses the names Egyptian, Sphynx, Pyramide, Obelisk, Nile, Cairo, the representation of the Sphinx and the representation of an Egyptian scene as trademarks for the same goods.

"The identity of resemblance of trademarks may be ascertained only by comparison of the marks with each other," Assistant Commissioner Moore holds. "If the one mark creates in the mind a picture corresponding to the essential characteristics of the other, or if both suggest the same object of thought, they may be said to bear such resemblance to each other as to confuse the mind of the public, but not otherwise.

"The name 'Pharaoh' does not in any way suggest any of the opposer's marks. On the contrary, the name creates in the mind thoughts corresponding to the historical events which occurred in Egypt during the reign of its ancient monarchs, including the miracles and tragedies related in the sacred writings.

"If the opposer's contentions were tenable, it would be possible by a wise selection of a term universal in its signification to practically monopolize all trademarks for a particular class of goods."

Americans Lease German Patent

AMERICAN patent rights covering a recently invented German process for automatically producing bas-reliefs, sculptures, medallions and like articles have been sold to an American corporation, according to a report to the Department of Commerce.

With the "camera gun" invented by Adelbert Szalardi you get your man's picture whether you hit or miss. A camera attachment works with the pressure of the trigger finger. Magnesium in the ammunition charge permits night photography. The film chamber may be locked with a key retained by the police

The process requires the use of a special stereoscopic camera and a "stereocomperator," which transfers the picture taken by the stereoscopic camera to the block of raw material upon which the design is to be sculptured.

The process, which is said to reproduce natural colors, is expected to be used in connection with advertising and the production of novelties.

"O–G–Goody"—"Eskimo Pie"

THE Eskimo Pie Corporation raised a novel question recently in opposing the registration of "O-G-Goody" as a trademark for a chocolate-covered ice cream confection. The basis of the opposition was that the opposer owns a patent for a confection to which the trademark "Eskimo Pie" has been applied and that the acts of the O-G Goody Company in selling its confection is an infringement of that patent.

The Patent Office, however, dismissed the opposition, declaring it has no jurisdiction, where the marks of the two parties are wholly dissimilar, to pass upon the infringement of a patent or upon questions of unfair competition generally.

Brown Wins His Patent Suit

ALBERT C. BROWN, of Chicago, inventor of an adjustable faucet famous throughout the plumbing trades, has won his suit for infringement against the Empire Brass Manufacturing Company. Brown's patent is for an adjustable faucet attachment such as is extensively used in kitchen sinks and laundry and bath tubs. It is designed to connect with hot and cold water supply pipes and has a mixing chamber and a single spigot faucet. All the elements of his combination are old except the adjustable connections between the faucet ports and the supply pipes.

The defendant relied upon the usual defenses of invalidity and non-infringement. Judge Westenhaver writes the opinion for the United States District Court for the Northern District of Ohio. He reviews some of the prior art cited by the defendant but finds they are not in the particular branch of the industry in which Brown made his invention. The fact that the plumbing trade has acquiesced over a long period in its validity he holds to be a strong point in Brown's favor.

"Defendant's purpose could be none other than to achieve adjustability," he says, "and it has done this by using an offset swivel connection instead of one curved or bent. It permits easy application of the combination faucets to hot and cold water supply pipes in the same manner and for the same purpose as taught and claimed by Brown when the off-center variation does not exceed one-half to five-eighths of an inch. To this extent, at least, it is an equivalent of Brown's adjustable link or pipe."

Inventions in Literature

HOW many inventors are there who realize that a patent may not be obtained on a device if the device has been fully described in a printed work, even though the writer never made one of the articles? That a published description may upset the validity of a patent was illustrated, in the case of John L. Brodie against the United States early this year, by the Court of Claims. Brodie was suing the government for royalties on hats made according to his patented design.

In declaring his patent invalid the court relied in part upon quotations from the following publications:

Homer's Iliad
Dictionaire du Mobilier Francais
La Nature
Scientific American

"It is rather startling," the court declares, "in connection with the consideration of this case to have attention called to an opinion by Judge Westenhaver of the Northern District of Ohio, in which, considering the validity of a patent on an automobile bumper, he, by way of illustration, said, 'shields, fenders and devices for purposes of protection are of immemorial antiquity. In the World War, when it was realized that some protection against shrapnel fire would be serviceable, the need was at once answered by the development of the steel helmet. In a commercial sense the steel helmet was new, but in a patentable sense it was not novel nor an invention.'"

Congratulations, Mr. Wrigley

GERMANS like American chewing gum so much that they have resorted to court action to permit greater importation of it. By a final decision of the Court of Appeals at Munich, chewing gum has been so reclassified as to reduce import duties on it from 300 to 100 marks per 100 kilograms. This reduction follows continued representations by importing houses in Germany assisted by consuls and the American commercial attaché.

Our own Department of Commerce reports that chewing gum, first offered for sale in China 12 years ago and its purchase limited largely to the American population, has increased as an export item from a few cases to approximately 1,000 to 1,200 cases a year. It is estimated fully 95 percent of the gum now sold in China is to the native Chinese.

Of the People, by the People, for the People

THE Lincoln Motor Company has lost two cases against other companies using the trademark "Lincoln." In refusing to cancel the registration of the name as a trademark for the shock absorbers of the Lincoln Products Company, Assistant Commissioner Moore declares:

"The Lincoln Motor Company has used its trademark only in connection with motor cars. The Lincoln Products Company uses the name 'Lincoln' and the portrait of Lincoln as trademarks for shock absorbers. A structure considered as a whole, and the parts of which it is composed, are different things, hence, have not the same descriptive properties."

In permitting the Lincoln Manufacturing Company to register "Lincoln" with a distinctive design as a trademark for automobile brakes and timers, he says:

"The applicant calls attention to many registered trademarks and to many names of companies and corporations in which the word 'Lincoln' appears. Judicial notice may be taken of this fact, and also of the fact that Lincoln is commonly employed as the name of individuals and also as a geographical name."

The Old Home Savings Bank

NOT only may the Bankers Utilities Company not collect anything from the Pacific National Bank, but the United States District Court for the Northern District of California holds that the patent for the mechanical book-shaped bank for home savings (invented by Butler Greer), upon which suit was brought, is invalid, because all of its

elements are old. The utilities company, licensee of the patent, had sued for infringement and for an accounting.

"The main question in this case," says the court, "is whether or not the book form of savings bank as shown and described and claimed in these letters patent was anticipated by the prior art. Among the patents introduced in evidence by defendant to show the various elements comprising the Greer patent construction, are the Fisher patent, the Von Eigen patent, and the Farrington patent.

"It should be noted that the contents of the file wrapper of the Greer patent fail to mention the above named patents, a fact which, I think, is persuasive that various elements of the Greer patent as claimed are old and anticipated. All of its elements are invalid, for the reason that all of them were old. Taken together, they also are invalid as being merely an assemblage of old elements which accomplished no new result.

"Let the decree be for the defendant."

No Trademarks for Service

THAT a company which sells service rather than commodities cannot register a trademark for articles it handles is made clear by Assistant Commissioner Moore in denying the application of Gregg and Son, of Indianapolis, to register a trademark for repaired, cleaned, renovated and dyed fabrics and furs.

"A trademark as such can have no existence apart from an article of commerce, and unless it is indicative of origin or ownership of the article," he declares. "The applicant admittedly is not a trader, and the articles to which it applies its private mark are not articles of commerce. The mark does not indicate origin or ownership."

"Ford" Mark Not Exclusive

THE Ford Motor Company has lost two actions recently to prevent others from using the name "Ford." In an action in the United States Court in New York to restrain the independent firm of Kelly and Stein from using "Expert Ford Service," Judge Thatcher rules.

"The words in their ordinary significance do not convey a false impression, and it does not seem to me proper to enjoin their use until the secondary meaning sought to be attributed to them by the plaintiff is more clearly established."

In a cancellation action in the Patent Office against John A. McAdoo who registered the trademark "Ford" for cigars, Assistant Commissioner Moore holds.

"It must be remembered that the word 'Ford' is not necessarily confined to the corporate name of the petitioner. It is a common word of our language used not only as a name for many persons, but also as a common noun and as a verb."

Day Gun Pad Patent Void

IN a suit brought by W. R. Jorgenson against F. D. Hawkins in the Circuit Court of Appeals of the Eighth District for injunction and damages for infringement, the court holds that J. S. Day's patent for a recoil pad for gun stocks is invalid. The court rules that the fastening of a hard rubber base plate to the gunstock and a relatively soft rubber pad to the hard rubber plate does not involve invention.

"Although the exact form of air cushion shown in the Day patent is not disclosed in the prior art," Judge Booth writes, "yet there was disclosure of such character that the change made by Day cannot in our opinion be classed as invention. Our conclusion is that the Day patent is void for lack of patentable novelty."

Victory for De Forest

THE decision of Judge Thompson in the Federal District Court, in holding Lee De Forest to be the first and original inventor of the feed-back circuit and the oscillating audion, will have a far reaching effect in the radio industry. Twelve of the claims of the celebrated Patent No. 1,113,149, issued to Edwin H. Armstrong, are held to be invalid.

Due to lengthy litigation, the De Forest patent did not issue until September 2, 1924. It will not expire, therefore, until 1941. In the meantime, De Forest has a monopoly over any forms of radio circuit which his patent covers. Also, he may now hold manufacturers to an accounting of profits accruing from any infringements since September, 1924.

Patents Recently Issued

Classified Advertising

Of Interest to Farmers

AUTOMATIC HAY SHAKER AND SEED SIFTER.—Adapted for attachment on practically any mowing machine, for separating the seed from the hay, and placing the hay rearwardly on the ground. Patent 1590259. J. F. Shelton, 192 Poplar Ave., Memphis, Tenn.

DIGGER ATTACHMENT FOR TRACTORS.—Which can be driven over two adjacent rows of potatoes or the like, for digging and delivering the potatoes at the rear. Patent 1592962. M. B. Sample, Elizabeth City, N. C.

HARROW.—Having a body formed of a plurality of bars which carry the harrow teeth, and are adjustably connected with one another. Patent 1595843. B. A. Williams, c/o Williams Mfg. Co., Watertown, Tenn.

WEED HARROW.—Which will operate, when drawn over a harrowed field, to automatically gather weeds from the surface and discharge the same in bundles. Patent 1594,085. D. Wills, Ocean Boulevard, Clearwater, Calif.

ATTACHMENT FOR PLOWS.—Adapted to be secured to the plow beam, after the usual plowshare has been detached, for affording facilities for shallow cultivation. Patent 1596825. W. J. Gales, c/o Oates, Fayetteville, N. C.

CULTIVATOR-FENDER REGULATOR.—Which can be readily adjusted to various heights at the will of the operator, and be locked in adjusted position. Patent 1596111. C. L. McKelvie, P. O. Box 246, Fort Collins, Colo.

Of General Interest

COMBINATION CURTAIN, DRAPERY AND SHADE SUPPORT.—Which may be easily attached, and easily adjusted to accommodate draperies of different widths without entirely removing the support. Patent 1594268. P. Machowicz, 174 Russell St., Brooklyn, N. Y.

TICKET.—Having the numerals printed not only on the obverse face but also in reversed relation upon the reverse face, for preventing forging. Patent 1597607. C. A. Lick c/o Weldon, Williams & Lick, Fort Smith, Arkansas.

MILK BOTTLE.—Which may be stood on either end or placed upon its side and held against rolling, and is open at both ends for thoroughly cleansing. Patent 1595040. T. A. Voss, Phoenicia, N. Y.

COMBINED FRAME WINDOW AND SCREEN.—Adapted for use interchangeably as a storm window or a fly screen, the interchanging being done without special tools. Patent 1595018. H. C. Mills, 3250 W. 126th St., Cleveland, O.

TOBACCO POUCH.—Of the flexible type, adapted to be carried in a pocket, and constructed to prevent the gradual discharge of the contents. Patent 1594989. L. and M. Auster, 229 4th Ave., New York, N. Y.

ELASTIC UNIT.—Of the type comprising a pair of slidably contacting in-elastic members yieldingly connected by a retractile spring. Patent 1594962. D. B. Jacobs, c/o Diamond X Ranch, Swan Valley, Idaho.

METHOD OF AND DEVICE FOR CEMENTING WELLS.—Which separates the cement from the mud during the passage of the cement into the well casing. Patent 1594448. A. Boynton, c/o Frontier Oil Co., City National Bank Bldg., San Antonio, Texas.

TOOTHBRUSH.—Especially designed to brush and clean the back of the teeth and between them, and to properly massage the gums. Patent 1595715. J. M. Dudley, c/o Dudley Bar Co., District Sales Office, Birmingham, Ala.

COMPARTMENT PLATE OR PLATTER.—In which provision is made for holding several different articles, and constructed sufficiently deep to be strong and durable. Patent 1595356. J. E. Moseman, c/o A. Baldwin & Co., New Orleans, La.

KNOCKDOWN SCREEN.—Which admits of the ready separation or assembly of the parts so that the material may be washed, and the screen conveniently housed. Patent 1595929. W. P. Rhodes, 8418 117th St., Richmond Hill, N. Y.

TELEPHONE STAND.—For attachment to a wall, the telephone may be swung to one side, and a shelf is included for taking down messages. Patent 1594460. H. Kosmos, 2546 W. Monroe St., Chicago, Ill.

BASKET.—Having a removably attached wire handle which may be locked in operative position, or in flat engagement to facilitate shipping. Patent 1595869. C. L. Rickenbrode, Ripley, N. Y.

WINDOW CLOSER AND RAIN OR SNOW EXCLUDER.—With means for maintaining a window in its open position, and automatically closing the window upon certain conditions in the immediate vicinity. Patent 1595951. E. Klonieeki, c/o E. Carney, 138 W. 31st St., New York, N. Y.

DISPLAY RACK.—For displaying merchandise, meats, or similar articles, adapted to be telescoped to occupy a minimum space when not in use. Patent 1595882. M. B. Sheldon, c/o American Wire Form Co., 265 Grand Ave., Jersey City, N. J.

SECTIONAL CABINET DOOR.—Whereby any number of sections may be associated, and the doors interlocked to protect and connect all the sections. Patent 1595875. H. Ruscher, c/o Tieset Office Equipment Co., Grand Central Terminal, New York, N. Y.

PORTABLE SCAFFOLD.—Which can be supported in rigid relation to a pair of ladders, readily assembled, and moved from place to place without disassembling. Patent 1593,945. J. J. Macklem, 5957 South St. Andrews Place, Los Angeles, Calif.

PIE TIN.—Formed of sections which may be readily interfitted for baking pie crust, and aiding in forming and maintaining the crust shape. Patent 1596331. E. N. Bassett, 322 Floral Court, Lincoln, Neb.

FOUNTAIN PEN FILLER.—Wherein the usual sack is eliminated and means provided for drawing a quantity of ink directly into the barrel. Patent 1596811. A. Craig, 150 Cooper St., St. James, L. I., N. Y.

POSTAL CARD.—In combination with an envelope, which serves to conceal an object contained, the post card stiffening and furnishing a little extra protection. Patent 1596088. M. H. Espey, Rising Sun, Ind.

DETACHABLE ANTISLIP HEEL.—Which may be readily applied to or removed from an ordinary street shoe, insuring a firm ground engaging trend. Patent 1596832. C. H. A. Heinemann, 186 Paterson Ave., East Rutherford, N. J.

MEANS FOR MOLDING MANHOLE FRAMES.—Whereby the output is very materially increased, and the work made possible in a foundry, not equipped with expensive machinery. Patent 1596815. E. F. Dooley and G. B. Scanland, c/o Hutchinson Foundry and Machine Co., Hutchinson, Kans.

TORPEDO.—So constructed that its turbine will be incapable of heating beyond a predetermined temperature, thus preventing injury to the turbine. Patent 1596845. S. B. Mac Farlane and M. Eppley, c/o Marion Eppley, 12 Sheffield Ave., Newport, R. I.

LIQUID LEVEL GAGE.—Particularly adapted for oil tanks of ships or other containers where the oil or liquid is partially above and partially below the gage. Patent 1596774. R. Star, 84 Flushing Ave., Brooklyn, N. Y.

TOOTHBRUSH.—By the use of which a more thorough cleansing of all the exposed surfaces of the teeth is insured. Patent 1596783. B. Weissman, 583 Riverside Drive, New York, N. Y.

FASTENING DEVICE.—For use in fastening gloves, curtains, and others articles where two pieces of material are to be brought together. Patent 1596342. E. A. Farron, 1330 Hyde Park Blvd., Chicago, Ill.

COMBINATION FLOOR CLEANER AND OILER.—Which will serve to take up dust and dirt, will wash the floor, dry the same and oil it. Patent 1597644. C. Wiener, c/o Betty Clair, 717 Lexington Ave., New York, N. Y.

COMBINED SOUND BOX AND SPEAKING UNIT.—By means of which sounds may be reproduced from the record of a talking machine or conveyed by radio. Patent 1597647. J. Fitzerman, 449 Stone Ave., Brooklyn, N. Y.

THERMOMETER AND GAGE TUBE.—Which effects the magnification of the column of

Two More Use "Three-in-One"

THAT a trademark may cover only the line of manufacture of its owner, and no more, is illustrated in the recent decisions in Patent Office oppositions where the Three-In-One Oil Company sought to prevent the Boston Brass Company from registering "3 in 1" and "2 in 1" as trademarks for boiler relief valves and the Lobl Manufacturing Company from registering "3 in 1" for hot-water bottles, ice bags and fountain syringes.

"It is the practice of this office to register the same mark in the name of different persons, firms or corporations where the mark is appropriated and used for merchandise having different descriptive properties," rules Assistant Commissioner Moore, "as evidenced by the registration of approximately 75 trademarks, of which judicial notice may be taken, consisting in some instances, of the notations '3 in 1' and in other instances of the notation '2 in 1.'

"The contention that the use of the mark by another, 'even for another class of goods,' would be calculated to rob the mark of its distinctive character and quality and cause the mark to become commonplace, could be made in every case in which the same mark is registered by different parties upon goods having different descriptive properties, and if sustained would result in but a single registration for registration of each mark. This is not the law."

Radio Swamps Patent Office

APPLICATIONS for radio patents are almost overwhelming officials of the Radio Division of the United States Patent Office. In spite of the fact that the number of examiners handling radio patent applications has been nearly tripled, the Radio Division is losing ground before the great influx of requests for radio patents—a greater influx than ever in the history of the office.

The Patent Office has been contending with the problem of an increasing number of radio patents for several years. When broadcasting first b[illegible] one division handled all radio, telep[illegible]nd telegraph patents. But the numbe[illegible] radio applications took such a jump following the popularizing of broadcasting that radio had to be divided into a separate division in August, 1924. There are now 12 assistants in the radio division alone.

Adaptation Is Not Invention

IN converting the "Kiddie-Kar" into a device to teach babies to walk, James I. Carroll is not entitled to a patent, the United States Circuit Court of Appeals for the Sixth Circuit holds in the cases of Frank F. Taylor against the Adrian Baby Carriage Company and the Wonder Manufacturing Company.

"All that Carroll has done," writes Judge Moorman, "is transfer to the Kiddie-Kar certain old parts of perambulators or baby exercisers, with the view of making them more efficient in the uses to which they had heretofore been devoted. He has mounted upon a Kiddie-Kar a ring to prevent the child from falling, spread its rear wheels, and substituted for its front wheel a fixed axle supported on wheels. In making the Kiddie-Kar utilizable in this manner for a child too young to be trusted with steering it, he did nothing more than any skilled mechanic could have done. He may have improved the old baby walkers or perambulators, but he has brought nothing new to the art."

fluid, whereby the reading is facilitated from both sides of the instrument. Patent 1597,608. S. Ligotz, 203 W. 62nd St., New York, N. Y.

DOLL.—The legs of which always assume natural positions, whether the figure is seated, or standing on one foot or both feet. Patent 1597600. J. L. Kallus, 1345 51st St., Brooklyn, N. Y.

VANITY-CASE CATCH AND PLATE EJECTOR.—Whereby the compact carrying plate may be easily removed without injury to any part of case with which it is associated. Patent 1597378. W. G. Kendall, 118 Market St., Newark, N. J.

SKIMMER BOAT.—Which makes use of a planning surface for exerting an auxiliary lifting action, affording least resistance, and a maximum speed from minimum power. Patent 1597209. W. C. Schults, 1878 60th St., Brooklyn, N. Y.

Hardware and Tools

HACK SAW.—Having a handle connected so that it can be adjusted about an axis parallel to the direction of the frame, and firmly secured. Patent 1595035. C. L. Troutman, 225 Wrinkles St., Elyria, Ohio.

WRENCH.—For turning the caps on grease cups, may be applied to a cap of any size within the range of the instrument. Patent 1594072. M. J. Schadeck, Box 93, Spreckels, Calif.

PLUG.—For use in connection with boilers, oil stills or similar capacities, a conical head engaging within an outwardly tapering conical opening. Patent 1595915. J. D. O'Brien, 2 Burling Slip, New York, N. Y.

SAW-FILING CLAMP.—Which is portable, and will dispense with the necessity of securing such devices to a workbench when in use. Patent 1594811. F. J. Bird, 92 7th St., San Francisco, Calif.

COMBINATION TOOL.—Constituting a hammer, a hatchet, wrenches, nail puller, pinch bar, and screw driver in a single useful household instrument. Patent 1596602. H. L. Eagan and O. C. Kinsolving, c/o O. C. Kinsolving, 917 Central Ave., Nashville, Tenn.

OYSTER OPENING DEVICE.—Which is of simple and durable construction, and capable of quickly opening or shucking oyster or the like. Patent 1597622. J. M. Richens, 638 W. 31st St., Jacksonville, Fla.

TOOL FOR APPLYING WIRE CLAMPS.—Conveniently manipulated to secure a wire clamp in place on a hose or like object, and twisting the wire ends to prevent loosening. Patent 1598345. F. W. Gunn, 318 Columbus Ave., Boston, Mass.

PORTABLE DRILL.—Using an explosive mixture as the power element, a closed chamber for the mixture, and a piston acting as an exhaust valve. Patent 1598476. F. Cribier, 68 Hudson Place, Weehawken, N. J.

TOOL FOR REMOVING BOILER TUBES.—Which functions to rip a longitudinal strip from the expanded end of the tubes to allow for withdrawing the same through the crown sheet. Patent 1598458. J. P. Sullivan, 399 Willis Ave., New York, N. Y.

Heating and Lighting

CAMP COOKING DEVICE.—Of light weight, compact storage, easily set up or taken down, and provides a rigid support for cooking utensils over an ordinary camp fire. Patent 1594708. H. M. Briggs, Suite 3, Mansur Block, Houlton, Mass.

WATER HEATER.—Wherein a pressure actuated switch is used to turn on an electric heating current immediately upon the flowing of the water. Patent 1595819. L. L. Bluemlein, Box 623, Hartsdale, N. Y.

GAS HEATER.—In which the radiants are associated with the fire-box to produce a flue through which air circulates, thus preventing loss of heat. Patent 1594744. F. I. Moore, c/o Moore Heater Corp., Long Beach, Calif.

HOT-AIR BLOWER.—Which is easy to manipulate, and whereby a jet of hot-air may be directed readily to any desired surface. Patent 1596837. A. Hopkins, c/o Hopkins Mfg. Co, 10 Brantine St., Allston, Mass.

BURNER.—Which utilizes hydrocarbon oil, which is thoroughly mixed and commingled with a highly heated gas before reaching the burner orifices. Patent 1596466. T. G. Van Brunt, 1086 President St., Brooklyn, N. Y.

RADIATOR.—Built up of a number of sections in which the headers are shaped to interlock, thus providing continuous bottom and top portions. Patent 1597082. De Witt T. Lyon, Buena Plaza Apts., 4363 Kenmore Ave., Chicago, Ill.

BURNER.—In which a novel assemblage is provided for spreading the flame and for controlling the flow of air and oil, thus promoting better combustion. Patent 1598528. A. Kais, 5659 Linwood Ave., Highland Park, Detroit, Mich.

STOVE.—In which the heat from one burner may be advantageously utilized to simultaneously heat a number of cooking utensils. Patent 1598339. H. M. Britan, Ojus, Fla.

Machines and Mechanical Devices

FLEXIBLE SKIRT PISTON.—Easily produced by ordinary molding, will effect a perfect fit to the cylinder, and will greatly reduce oil pumping tendency. Patent 1590616. L. R. Davis, 274 Grove St., San Francisco, Calif.

DIESTOCK.—Which is compact in structure and may be used with a hand lever instead of motor driven apparatus, may be quickly adjusted. Patent 1592170. E. J. Wilkinson, 3648 Monroe St., Gary, Ind.

SNOW REMOVER.—In the nature of an attachment for trucks, and particularly suited for breaking up and removing hard crusted snow stored in piles. Patent 1593523. P. Wright, 639 E. Jackson St., Medford, Ore.

MEANS FOR CONTROLLING FLUIDS.—By an arrangement of valves and plungers controlling the direction of flow of steam to "crack" and open the valve and cause the same to close. Patent 1592889. R. F. Knight, Box 345, Ramsey, N. J.

LOOP WHEEL OF CIRCULAR-KNITTING FRAMES.—Having an arrangement whereby to properly determine the direction and the planes of the sinkers of the loop wheel. Patent 1593463. G. Nigra, c/o G. Capuccio, via Arsenale N. 17, Turin, Italy.

CARPET BEATER.—Having means for arresting the movement of the beater element to relieve the device and the operator of unnecessary shock and jar. Patent 1593479. H. P. Thiele, 278 No. 7th St., Newark, N. J.

WASHING MACHINE.—In which the cover may be opened while the device is in operation without first disconnecting any part of the mechanism. Patent 1593716. N. Fox, Emery, S. D.

ELECTORAL APPARATUS.—For collecting and counting votes, by a mechanism by which each voter may see the tally of his own vote, without violating secret balloting. Patent 1593045. C. L. Sturges, 344 Yale Ave., Claremont, Calif.

FLUID-TRANSMISSION MECHANISM.—Which is entirely contained within the flywheel of an engine, enclosed against dust and injury applicable to motor vehicles or other devices. Patent 1593059. W. C. and A. R. Buckbee, P. O. Box 935, Crockett, Calif.

SEMI-AUTOMATIC TRIP FOR POWER SHOVELS.—Which may be actuated at any time through the manipulation of a lever associated with the control lever of the shovel. Patent 1594629. G. G. Morin, 40 Florence Ave., Holyoke, Mass.

SANITARY STREET CLEANER.—Manually moved over the street, or other surface, and causing a rotary brush to thoroughly clean the surface without raising any appreciable dust. Patent 1595056. E. Boyance and M. Pekary, 600 W. 150th St., New York, N. Y.

POTATO CUTTER.—Operable to produce a novel form of sliced potatoes, in which the product will remain crisp when cooked. Patent 1594996. A. W. Brown, 315 Washington St., Peekskill, N. Y.

PIPE-STRAIGHTENING ATTACHMENT FOR PRESSES.—More especially punch presses whereby such machines may be easily and quickly adapted to the straightening of pipes and tubes. Patent 1594439. T. W. Williams, Oil Hill, Kans.

PRINTING PRESS.—Having inking ribbon mechanism movable over the type bed for the purpose of producing imitation typewritten letters. Patent 1594800. C. T. Spear, Box 378, Texarkana, Texas.

COUPLING CONNECTION FOR PUMP RODS.—Adapted to be releasably secured to a vertically reciprocable part in connection with the mechanism of a windmill. Patent 1594,784. A. L. Ligon, Longfellow, Texas.

MECHANICAL MOVEMENT.—For converting a rotary motion into a reciprocatory motion for reciprocating a shaft and rotating the same. Patent 1594556. J. W. Pitts, 97 Owens Ave., Detroit, Mich.

SCREEN.—Adapted particularly to a perforated well tube for preventing the passage of sand and small stones between the tube and the screen. Patent 1594788. M. J. McLaughlin and D. J. Harrison, c/o Huggins, Kayser & Liddell, Chronicle Bldg., Houston, Texas.

ROD COUPLING.—Which will efficiently hold together the ends of rod sections, and may be quickly applied or detached therefrom. Patent 1594698. E. R. Thomas, Denoya, Okla.

DEEP AND SHALLOW WELL CYLINDER PROTECTOR.—Having means for preventing rust, scale, sand, etc., from interfering with the operation of the plunger and valves. Patent 1594745. A. B. Mueller, 103 Isabelle St., San Antonio, Texas.

PROCESS FOR SEPARATING HYDROCARBONS FROM OIL-BEARING EARTH.—By means of water, steam and agitation in a closed container and correlated open containers. Patent 1594796. G. J. Rockwell, 138 So. Stafford Ave., Huntington Park, Calif.

MACHINE FOR SECURING HANDLES TO BASKETS.—For containing grapes, etc., providing means for securing the handle terminals adjacent the rim, and clinching them in position. Patent 1595868. C. L. Rickenbrode, Ripley, N. Y.

APPARATUS FOR DRYING EGGS.—Whereby the resultant product will be more soluble than is usual, particularly such products as albumen and whole eggs. Patent 1595,778. U. S. Harkson, c/o Henniagson Bros., 105 Hudson St., New York, N. Y.

APPARATUS FOR PEELING ARTICLES.—Such as vegetables and fruits, by a direct application of heat, without damaging the bodies of the articles. Patent 1595954. J. Q. Leavitt, P. O. Box 364, Ogden, Utah.

PISTON RING.—In which means of connection between sections is provided to lock the same together for radial expansion or contraction. Patent 1595890. C. H. Taylor, Biloxi, Miss.

GATE.—Having mechanism adapted to be operated without the driver of a vehicle having to dismount or stop the vehicle as it passes through. Patent 1595524. M. H. Poole, 515 7th Ave., So., Great Falls, Mont.

LUBRICANT CUP.—With spring pressed plunger, automatically regulating the flow of lubricant, whereby the volume will be practically constant. Patent 1595157. H. E. Hoover, Route 8, Wabash, Ind.

CORER.—For apples, tomatoes and other fruits or vegetables, the apparatus will not only cut a circular opening but will sever the core. Patent 1595953. J. Q. Leavitt, P. O. Box 364, Ogden, Utah.

TYPE-BAR MECHANISM.—Which will provide for power where needed, and speed of movement where speed and not power is most desired. Patent 1595847. A. N. Woodruff, Box 1907, Washington, D. C.

CLUTCH.—Especially adapted for use in well drilling, providing an internally expanding clutch capable of adjustment to compensate for wear. Patent 1594105. J. W. Miller, 311 No. Raymond Ave., Pasadena, Calif.

Pertaining to Vehicles

VARIABLE-SPEED-TRANSMISSION MECHANISM.—Which can be adjusted while the drive member is rotating to render the mechanism ineffective, or to give varied speeds. Patent 1594753. E. B. Rayner, Box 361, Piqua, Ohio.

ATTACHABLE BLADE.—Adapted to be applied to different types of non-skid chain devices, such as are used for automobile tires. Patent 1594950. A. G. Hartung, c/o G. Breuer, Maipu 671, Buenos Aires, Argentina, S. A.

DEVICE FOR MOUNTING DISK VEHICLE WHEELS.—By which the wheel may be slid easily to bring the stud openings in the disk in registration with the studs carried by the hub. Patent 1595930. L. I. Sieven, 1461 45th St., Brooklyn, N. Y.

HEADLIGHT FOR MOTOR VEHICLES.—In which two sources of light and two reflectors are employed in each unit, each focused upon different portions of the road ahead. Patent 1595173. R. B. Stiert, Box 235, Sapulpa, Okla.

AUTOMOBILE HEADLIGHT CONTROL.—Actuated by the movement of the steering wheel, throwing the light upon the road in the direction of turning. Patent 1595879. H. Schjotz, C. Staugaard and F. Schlueter, 6781 Vinewood Ave., Detroit, Mich.

CLAMP.—For exerting pressure on tires during vulcanizing, the maximum of pressure being exerted at a plurality of points by a single means. Patent 1595914. E. Nestler, 245 W. 55th St., New York, N. Y.

TRAILER HOIST AND COUPLER.—Which will transmit power from the engine of the tractor to one end of the trailer for raising or lowering the same. Patent 1595902. W. Mayer, 239 E. 5th St., Brooklyn, N. Y.

UNIVERSAL WHEEL DRIVE.—Particularly as applied to the front wheels, being dust proof, rugged, compact, and having little influence on the steering. Patent 1594103. M. G. McNeely, Box 201, Fruitville Station, Oakland, Calif.

AUTOMOBILE LOCK.—For use in connection with the steering apparatus by means of a permutation lock thereby avoiding keys. Patent 1594091. J. Clifford, 1039 92nd Ave., Oakland, Calif.

DIMMER FOR AUTOMOBILE HEADLIGHTS.—Immediately associated with the reflector, breaking the light rays at their source rather than while passing through the lens. Patent 1594075. E. J. Smythe and A. Kerr, Fairbanks, Alaska.

STEERING-WHEEL THROTTLE AND SPARK CONTROL.—Which may be operated by the driver's hands without in any way shifting the position of the hands on the wheel. Patent 1593876. R. Learmont, Box 9, Boorowa, New South Wales, Australia.

MOTOR VEHICLE WHEEL.—More particularly of the disk type, for facilitating the holding, removal, and replacement of pneumatic tires, and preventing rotary movement of the disk. Patent 1596097. L. W. G. Grieves, c/o Grieves Rapid Demountable Lock Wheel Co., 91 Queen St., Auckland, New Zealand.

VENTILATING DEVICE FOR VEHICLES.—In which means is provided for conveying fresh air into closed vehicles and forcing the foul air out, without causing a draft. Patent 1596064. A. Mortimer, c/o Michael Clancy, 8258 S. Green St., Chicago, Ill.

DEVICE FOR USE IN ADJUSTING FOOT BRAKES.—Which holds the foot pedal of an automobile in proper position while tightening the nuts on the springs of the brakes. Patent 1596834. P. Herbert and J. M. Withee, Box 149, Rumford, Me.

PUMP.—For forcing air into an automobile tire, and having novel means for supplying lubricant to the moving parts of the pump. Patent 1596356. R. D. Hughes, c/o Red Giant Tool Corp., Lynchburg, Va.

ANTISKID DEVICE.—In the form of an attachment for vehicle wheels, especially automobiles, for use when the pavement is ice coated. Patent 1596796. K. E. Blum, 2345 Broadway, New York, N. Y.

VEHICLE RUNNING BOARD.—By means of which dirt and the like may be scraped from the shoes before entering the car. Patent 1597638. C. L. Vincent, 79 Carmel St., New Haven, Conn.

ANTISKID CHAIN.—Which can be readily adjusted to any ordinary tire, and provides means for taking up slack after the device is positioned. Patent 1597596. C. A. Hartfiel, 2098 Lexington Ave., New York, N. Y.

TRAVELING ADVERTISING DEVICE.—In the form of a vehicle, which affords facilities for supporting a plurality of rotary display units operating at spaced intervals. Patent 1597262. J. H. Bloodgood, 3210 No. A St., Tampa, Fla.

AUTOMOBILE DIRECTION SIGNAL.—A simple unit which can be readily attached to or removed from, an automobile, and operated from an enclosed car. Patent 1597624. S. Schussel, 8414 89th St., Woodhaven, L. I., N. Y.

TRAPDOOR FOR AUTOMOBILE FLOORS.—Which may be applied to any part of the floor, readily opened and automatically closed, or adjusted to remain open. Patent 1597569. G. W. Barringer, Lawrence, N. Y.

Designs

DESIGN FOR A DOLL'S CRADLE.—Patent 70760.—E. Holleback, Davison, Mich.

DESIGN FOR AN AUTOMOBILE SIGNAL CASING.—Patent 70770. J. Martin, 440 Lewis Ave., Brooklyn, N. Y.

DESIGN FOR A BOX.—Patent 70774. F. A. Purchas, McGraw, N. Y.

DESIGN FOR A WOVEN FABRIC OR SIMILAR ARTICLES.—Patent 70782. L. Bluhm, c/o Phoenix Mfg. Co., 40 Thomas St., New York, N. Y.

DESIGN FOR A BOX.—Patent 70897. F. A. Purchas, McGraw, N. Y.

Our Book Department

THE STORY OF STEEL

By J. Bernard Walker

Editor Emeritus, Scientific American

If one were asked to name the most important industry in the United States, he would be safe in naming that of steel. To put this thought in the words of the author of the above book, "If the writer were asked to name the principal agent in the enormous growth in wealth of this country during the past two decades, he would unhesitatingly name the vast iron deposits of the Lake Superior region and the consequent phenomenal growth of our steel industry." Nature was extraordinarily generous when she was preparing the territory of the United States as a habitation and development of man. Nowhere in the wide world is to be found such an aggregation of rich, natural resources—forests, soil, rivers, water power, coal, and oil, to say nothing of minerals. Of all these, perhaps the most amazing—we had almost said sensational—is the enormous deposits of unusual rich iron ore averaging 50 percent pure iron which extends for one hundred miles or more north of and parallel with the north shore of Lake Superior. "The Story of Steel," is an attempt to deal with the larger aspects of the vast steel industry in such a way that the reader—whether he be technically instructed or not—will be particularly informed upon a subject of universal interest. Preparatory to writing this book, Mr. Walker made an extended trip throughout the properties of the United States Steel Corporation and his story is based upon what he saw throughout this journey of several weeks duration. From the mining of the ore in the Missabe Range where the famous Hull Rust Mine opens its huge gap—an excavation many times larger than the Culebra Cut, Mr. Walker follows the ore to the vast ore docks, where on a test some 14,000 tons have been loaded into a ship in 16½ minutes, then accompanying the ore on its trip down the Great Lakes to the blast furnaces at Lorain, Gary and elsewhere. Separate chapters are given to the smelting of the ore in the blast furnace, the treatment of the molten iron in the Bessemer converter and in the open hearth furnace and the electric furnace, to turn it into steel in the shape of the ingot. Then follow a series of chapters on the manufacture of the steel into the principal finished products of the steel industry. The human side of the industry is dealt with in chapters on safety and general welfare work. Although the study upon which this work is written was confined mainly to the activities of the United States Steel Corporation, the general practice in steel making is so similar throughout the industry that these chapters may be taken as truly representative of the industry as a whole. The style of the book is characterized by the clarity of diction and touch of imagination which distinguish the author, and the immensity of the various plants and the truly sensational size of the machinery employed are here vividly and entertainingly set forth. When it is borne in mind that the steel industry is turning out finished products at the rate of over forty million tons per annum, it will be realized that a large force and much knowledge and skill is needed in distributing this huge tonnage from the time it reaches the loading platforms at the finishing end of the mills. This important work is described in a chapter entitled, "Distributing the Finished Product." The last two chapters on the marketing of steel and the financing of the industry, written by Edmund Brown, Jr., add greatly to the value of this work. Published by Harper Brothers.

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Vol. 135, No. 5. Published monthly. Entered as second class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

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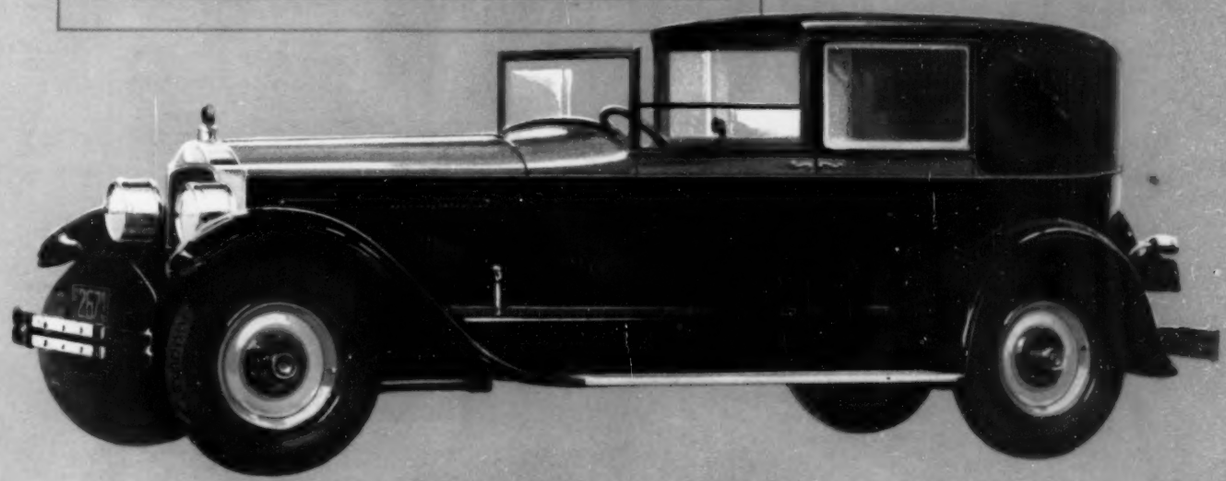

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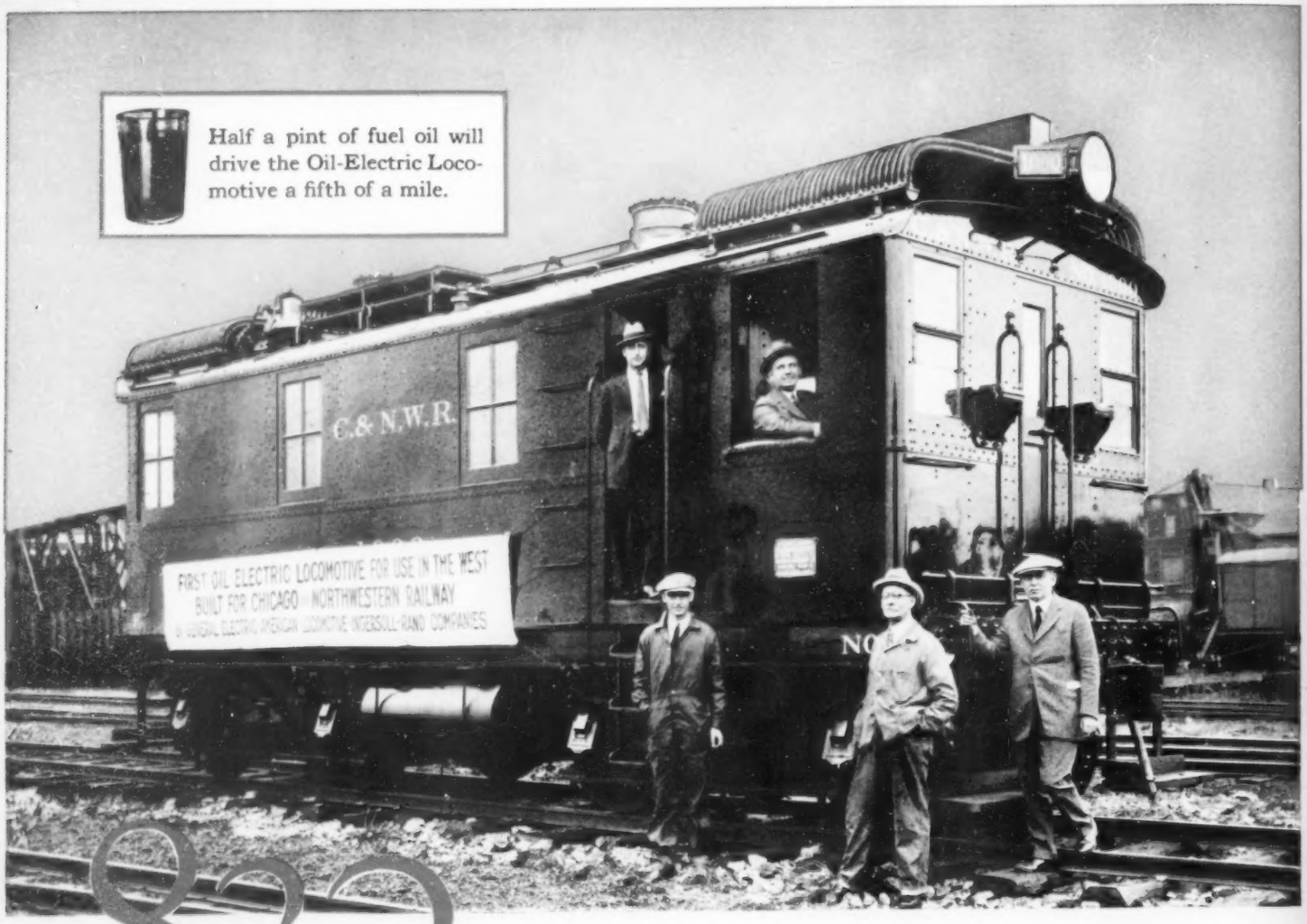
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